CHAPTER 3: RESOURCES AND ENVIRONMENTAL IMPACTS

Introduction

Scope of Environmental Issues

The SCR systems would physically be a minor addition to an expansive heavy industrial facility having a significant property buffer area. The plant areas proposed for installation of the SCR reactors, ammonia storage and unloading area, inter-connecting ammonia and service water piping, electrical conduits, retention basin, wastewater piping, construction staging area, railroad spur, and temporary buildings have all been heavily disturbed by previous plant development activities (see Figure 3). No new facilities would be required to unload large equipment transported to the site by barge. As a result, the potential would be small for construction impacts to terrestrial ecology, aquatic ecology, noise, land use, air quality, visual aesthetics, and archaeological and historic resources.

Operational impacts are primarily dependent on the engineering features and safeguards of the proposed SCR systems. These features and safeguards would control the probability and extent of accidental or unintentional releases of anhydrous or aqueous ammonia to the environment. These potential releases and attendant impacts would be:

- Excessive ammonia slip passing through the SCR reactors could result in ammonia contamination of the air heater wash causing potential effluent toxicity and/or odor. Additionally, fly ash could become contaminated with ammonia and sluiced to the ash pond causing potential effluent toxicity.
- Accidental releases of anhydrous ammonia to the air from the storage and unloading system or truck causing a potential hazard to plant operating personnel, the public, and the environment.
- Direct accidental releases of anhydrous ammonia or aqueous ammonia to surface water causing damage to aquatic life.

A number of assumptions concerning the proposed SCR systems and their operation are necessary to establish the basis for analyzing the potential environmental impacts of the proposed action. These assumptions are summarized here and addressed in more detail as appropriate in subsequent sections analyzing specific resource areas. Some of these assumptions and other measures are also environmental commitments listed under **Summary of Environmental Commitments** in Chapter 2.

SCR Reactor

Design, Construction and Operational Assumptions

1. An 90% NO_X removal rate would be achieved under normal operations throughout the life of the system, excepting potential periods near the end of the catalyst life.
2. The SCRs would operate as needed to meet air quality requirements. Although the SCRs are designed for year round operation, their operation during the ozone season of May through September is expected to be adequate to address the concerns for ambient air quality with respect to ozone.
3. An ammonia slip of 2 ppm would not be exceeded during normal operation.

4. Catalyst disposal would be managed by a catalyst contractor in compliance with applicable regulations.

Anhydrous Ammonia System

Design, Construction and Operational Assumptions

1. Two 30,000 gallon (nominal) storage tanks would be installed.
2. A water fogging system with both automatic and manual activation would protect both the storage tanks and the truck/railcar off-loading area by limiting the hazard from large ammonia leaks or catastrophic tank failure.
3. The drainage from the proposed ammonia unloading and storage area would be re-configured to contain the aqueous ammonia generated by operation of the fogging system within the compacted earth berm surrounding the ammonia unloading and discharge facility.
4. The applicable chemical accident prevention measures required under 40 CFR 68 would be implemented prior to filling of the anhydrous ammonia storage system or receipt of ammonia in quantities exceeding 10,000 lbm.
5. Appropriate personal protective equipment (respirators, self-contained breathing apparatus, protective clothing) and training would be provided to operating personnel consistent with Occupational Safety and Health Administration (OSHA) regulations.

Air Quality

Resource Description

The air quality in the vicinity of BRF is generally good, with the area in compliance with all air quality standards. Regionally, air quality is also generally good. For some urban areas, however, attainment of the 1-hour ozone standard has been difficult. Until recently, for example, both Memphis and Nashville, Tennessee were designated as ozone non-attainment areas. These areas, in addition to others (including Knoxville) are expected to experience periods when ozone levels will be above the recently adopted 8-hour ozone standard of 80 ppb. Some areas are also expected to experience periods when fine particulate concentrations will be above the recently adopted annual PM-2.5 standard. It should be noted, however, that in May 1999, standards were successfully challenged in a Federal Circuit Court and remanded to EPA for further action and analyses. The Circuit Court decision was appealed to the U. S. Supreme Court, which sent the matter back to EPA for better establishing the scientific basis for the two standards. It may be a year or more before these matters are ultimately resolved.

Impacts of No Action

Under the no action alternative current air quality in the vicinity of BRF is expected to stay at current levels.

Construction Impacts

Under the action alternative transient air pollutant emissions would occur during the construction phase of this project. Since the Bull Run site has already been developed as an industrial site, construction-related emissions would be relatively less than for a new site. Construction-related air quality impacts are primarily related to land clearing, site preparation, and the operation of internal combustion engines.

Vehicle Emissions and Excavation Dust

Land clearing, site preparation, and vehicular traffic over unpaved roads and construction sites result in the emission of fugitive dust PM during site preparation and active construction periods. The largest size fraction (greater than 95% by weight) of fugitive dust emissions would be deposited within the construction site boundaries. The remaining fraction of PM would be subject to longer-range transport. If necessary, open construction areas and unpaved roads would be sprinkled with water to reduce fugitive dust emissions by as much as 50%.

Combustion of gasoline and diesel fuel by internal combustion engines (vehicles, generators, construction equipment, etc.) would generate local emissions of PM, NO_X, carbon monoxide (CO), volatile organic compounds (VOCs), and SO_2 throughout the site preparation and construction period. The total amount of these emissions would be small and would result in minimal off-site impacts.

Air quality impacts from construction activities would be temporary and dependent on both manmade factors (e.g., intensity of activity, control measures, etc.) and natural factors (e.g., wind speed, wind direction, soil moisture, etc.). However, even under unusually adverse conditions, these emissions would have, at most, a minor, transient impact on off-site air quality and should not lead to an exceedance or violation of any applicable ambient air quality standard. Overall, the air quality impact of construction-related activities for the project would not be significant.

<u>Plant Vicinity Operational Impacts</u>

Operation of the SCR would not adversely impact local air quality. There would be the possibility, however, of slight increases in ammonia concentrations downwind of the plant site. This possibility is discussed below. Overall, SCR operation would improve air quality.

Ozone Scavenging Losses

Ozone concentrations below background levels occur immediately downwind of NO_X sources, such as power plants, due to ozone scavenging, i.e. NO emissions consuming ozone. Significant ozone production does not occur until 20 to 80 km downwind of the NO_X source. The reduction of NO_X emissions may reduce the size of the area in which ozone scavenging occurs. While ozone concentrations may increase in areas previously affected by ozone scavenging, they are not expected to increase above background ozone levels.

Plume Opacity and Plume Blight

Plume opacity is determined by the amount of NO_X and PM emitted. Due to the optical properties of NO_X and fine particulate, these pollutants tend to give a plume a slight reddish-brown color when viewed against a clear sky. Since the SCR will greatly reduce NO_X emissions, it is also expected to reduce plume opacity and plume blight. There is a possibility that SCR operation will be accompanied by an increase in SO_3 emissions which could result in some offset of the plume visibility improvements due to NO_X reduction. Since there is little experience with SCR on large utility boilers, quantification of this potential increase in SO_3 emissions is not possible. The potential exists, however, for minor increases in plume visibility and plume blight under some meteorological and operational conditions.

Regional Operational Impacts

Introduction

The primary purpose of the SCR installation is to reduce emissions of NO_X, a pollutant which can, in combination with VOCs and sunlight, lead to the production of ozone. The purpose of this section is to describe the nature of ozone and the impacts that reducing NO_X emissions from BRF will have on ambient ozone levels. In addition, the potential impact of the SCR operation on secondary particulate formation and regional haze is described.

Ozone

Ozone is a pollutant which is formed in the atmosphere as the result of exposure to sunlight of a mixture of NO_X and VOCs. Both NO_X and VOCs have natural and anthropogenic (man-made) emissions sources. For example, isoprene (a VOC important in ozone formation) is primarily emitted from trees and crops. Other VOCs, however, are emitted into the atmosphere as the consequence of human activity such as the use of solvents or the operation of motor vehicles. While there are also natural sources of NO_X they are relatively small compared to the NO_X emitted from motor vehicles and other forms of fuel combustion. Since large utility boilers burn large quantities of fossil fuel, they are a major source of the NO_X emitted into the atmosphere.

Ozone levels in the TVA region have historically been less than the national ambient air quality standard (with the exception of a few urban centers). With the recent revision of the ozone standard from a 1-hour average concentration of 120 ppb to an 8-hour average of concentration of 80 ppb, more areas in the TVA region are expected to experience ozone concentrations exceeding the standard. Furthermore, it is anticipated that a number of urban areas--even some remote, rural areas in the Appalachian Mountains--which barely met the former 1-hour standard will experience ozone concentrations above the 8-hour standard. As previously noted, the 8-hour standard has been remanded by the U. S. Supreme Court for further review and analyses.

Although it is not possible to quantify the change in ambient ozone concentration (or the frequency of that change) at a specific place due to NO_X emissions reductions at BRF, it is known from previous modeling and air quality research that the overall effect would be to reduce the amount of ozone produced in the atmosphere. It is also known that the area that would benefit the most would be the area within about 150 km downwind from BRF.

Secondary Particulate and PM-10/PM-2.5

Operation of an SCR requires the use of ammonia. Although almost all of the ammonia is chemically converted to nitrogen and water in the reactions that are responsible for the reduction in NO_X emissions, there is a possibility that some ammonia would be emitted from the stack. Since ammonia is associated with the formation of particulate in the atmosphere, any ammonia that is emitted has the potential to result in the formation of additional atmospheric particulate. Therefore, allowing ammonia to slip through the system without reacting can lead to the formation of particulate leading to a slight increase in the atmospheric particulate burden. The potential for a small increase in particulate due to ammonia emissions would be more than offset by the decrease in particulate due to NO_X reductions associated with SCR operation (NO_X is a source of secondary particulate).

Cumulative Impacts to Air Quality

Introduction—TVA's Proposed NO_X Control Strategy

TVA is considering the installation of additional NO_X controls, using SCR technology, at up to six other coal-fired power plants (Allen, Cumberland, Paradise, Widows Creek, Kingston and Colbert). Table 2 lists all units being considered including the proposed action at Bull Run. This strategy, which goes beyond current regulatory requirements, would reduce TVA coal-fired power plant NO_X emissions by 75,000 metric tons (83,000 tons) during the ozone season (May to September) beginning in 2003. When combined with other controls already planned to meet the acid rain requirements under the CAA Title IV, the total NO_X reduction during the 2003 ozone season will be 152,450 metric tons (168,000 tons). To meet Title IV requirements, low NO_X burners have already been installed or will be installed by 2000 on 34 TVA boilers with over-fire air on 6 units and combustion optimization on an additional 18 units. The controls would reduce TVA's seasonal NO_X emissions roughly 71% below 1990 levels.

Table 2. TVA Fossil Plant Units Planned for Installation of SCR Systems.

Unit	State	Generation Capacity (MW)	Estimated Installation
Paradise 2	Kentucky	704	2000
Paradise 1	Kentucky	704	2001
Paradise 3	Kentucky	1,050	2003
Allen 2	Tennessee	330	2002
Allen 3	Tennessee	330	2002
Allen 1	Tennessee	330	2003
Widows Creek 7	Alabama	575	2003
Widows Creek 8	Alabama	550	2004
Cumberland 2	Tennessee	1,300	2004
Cumberland 1	Tennessee	1,300	2003
Bull Run	Tennessee	950	2003
Kingston 1-5	Tennessee	900	2004
Kingston 6-9	Tennessee	800	2003
Colbert 5	Alabama	575	2004
Colbert 1-4	Alabama	800	2005

Because the SCR installations listed in Table 2 would satisfy most if not all of TVA's requirements, there are currently no plans to install SCR systems at other units at Johnsonville, Widows Creek Units 1-6, Gallatin, John Sevier, and Shawnee Fossil plants. NO_X reduction from these units using SCR systems is more costly and produces less significant environmental benefit than the units identified in Table 2.

The new controls would help reduce local and regional ozone levels, and would help prevent violations of the new more stringent 8-hour ozone standard that was promulgated by EPA in 1997. The strategy is also consistent with the types of controls that would be needed to comply with EPA's proposed rule for ozone transport, known as the ozone transport SIP call.

NO_X emitted into the atmosphere leads to the formation of ozone and fine particulate, as well as contributing to increased acidity of precipitation. Thus, the cumulative impact on air quality (due to a reduction in NO_X emissions) would be beneficial.

Ozone Reduction

Precise quantification of ozone changes due to the proposed action is not practical or possible due to daily variations in meteorology and operating conditions. It is possible, however, to assess the overall impact of the proposed action in combination with anticipated NO_X reductions at other TVA fossil plants. This assessment is possible by comparing the results of photochemical modeling performed with and without consideration of TVA's overall NO_X reduction strategy. Specifically, modeling was performed as part of the effort of the OTAG's work which considered the NO_X and VOC emissions in the eastern half of the U.S. projected to the year 2007. Photochemical modeling was performed with the OTAG emissions databases modified to reflect the effect of TVA's NO_x strategy. Although modeling was limited to a single 10-day episode in 1995 the results are illustrative of the effect of TVA's NO_X reduction strategy on atmospheric ozone. Within Alabama, Kentucky and Tennessee the modeling indicated that TVA's NO_X reduction strategy would decrease the overall peak 1-hour ozone in the ambient atmosphere by 2, 4 and 4 percent, respectively, and the peak 8-hour ozone burden would be decreased by 2, 3 and 4 percent, respectively. (It is important to note that the modeling did not account for additional NO_X emissions reductions that are likely to occur from other utilities as a consequence of recent EPA action establishing statewide NO_X budgets in the eastern states.

Ammonia Storage and Handling Safety

Introduction

Anhydrous ammonia is 99.5% commercial grade ammonia (with 0.5% water) as compared to aqueous ammonia which is a solution of ammonia and water. A saturated aqueous ammonia solution is 47% ammonia by weight at 32°F and at atmospheric pressure (by comparison household ammonia is a 5% solution). Anhydrous ammonia is very volatile and boils at –33.3°C under atmospheric pressure. Anhydrous ammonia must be pressurized or refrigerated to be maintained as a liquid. Air mixtures of ammonia are difficult to ignite. The autoignition temperature is 650°C. The lower explosive level is 16% by volume and the upper explosive level is 27% by volume. The reportable quantity (RQ) under the Comprehensive Environmental Responsibility, Compensation and Liability Act (CERCLA) for release of ammonia is 100 lbm.

A typical material safety data sheet (MSDS) for anhydrous ammonia is given in Appendix A. Excerpts from the MSDS concerning the acute and chronic health hazards are as follows:

> *Inhalation: Vapor may cause irritation to the respiratory tract. High atmospheric concentrations in excess of the occupational exposure limit may cause injury to the mucous membranes. Fluid build up on the lung (pulmonary edema) may occur up to 48 hours after exposure to extremely high levels and could prove fatal. The onset of the respiratory symptoms may be delayed for several hours after exposure.*

Skin Contact: High concentrations of vapor may cause irritation. By rapid evaporation, the liquid may cause frostbite.

Eye Contact: The vapor is an irritant but the liquid is a severe irritant. Liquid splashes or spray may cause freeze burns. May cause severe damage if eye is not immediately irrigated. The full effect may occur after several days

Ingestion: Will cause corrosion of and damage to the gastrointestinal tract.

Long-term Exposure: This material has been in use for many years with no evidence of adverse effects.

Air concentration thresholds have been established for ammonia as guides for purposes of monitoring short-term and long-term occupational exposure, and for the purpose emergency planning. These threshold concentration values for ammonia vapor, their application, and the reference guideline, standard or regulation are listed in Table 3.

Table 3. Ammonia Concentration Limits.

Concentration	Application	Reference
25 ppm (17.75 mg/m^3)	Recommended exposure limit for 10 hour work day during a 40 hour work week	NIOSH Guide and ACGIH
35 ppm (24.85 mg/m^3)	Short-term exposure limit not to be exceeded in a 15-minute period	NIOSH Guide and ACGIH
50 ppm (35.5 mg/m^3)	Permissible exposure limit	OSHA
197 ppm (140 mg/m^3)	The concentration that defines the endpoint for a hazard assessment of off-site consequences	40 CFR 68
500 ppm (355 mg/m^3)	Concentration that is immediately dangerous to life or health for a worker without a respirator with an exposure time greater than 30 minutes	NIOSH Guide and ACGIH

The toxic endpoint concentration for ammonia, based on Emergency Response Planning Guideline 2 (EPRG-2) is 197 ppm (140 mg/m^3 or 0.14 mg/L). It was developed by the American Industrial Hygiene Association (AIHA) and is defined as the maximum airborne concentration below which nearly all individuals can be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.

Anhydrous Ammonia Safety

The storage and handling of anhydrous ammonia in large quantities is a potentially significant hazard. This necessitates attention to the engineered features, control and mitigation safeguards, and operating procedures and training for plant personnel. Applicable guidelines, standards and regulations related to the use of anhydrous ammonia are listed below.

- American National Standard Institute (ANSI) Standard K61.1 (Compressed Gas Association (CGA) Standard G-2.1)— Storage and Handling of Anhydrous Ammonia
- 29 CFR 1910.38 - Employee Emergency Plans and Fire Protection Plans
- 29 CFR 1910.111—Storage and Handling of Anhydrous Ammonia
- 29 CFR 1910.119—Process Safety Management of Highly Hazardous Chemicals
- 29 CFR 1910.1000 - Air Contaminants
- 40 CFR 68—Chemical Accident Prevention Provisions
- Pocket Guide to Chemical Hazards—National Institute for Occupational Safety and Health (NIOSH)
- Threshold Limit Values for Chemical Substances—American Conference of Governmental Industrial Hygienists (ACGIH)
- Emergency Response Guidebook—U.S. Department of Transportation

The applicability of standards and regulations are generally triggered by the quantity of ammonia stored. These quantities are called threshold quantities and are listed in Table 4.

Table 4. Regulatory Threshold Quantities for Ammonia.

Chemical	Threshold Quantity	Federal Regulation
Anhydrous Ammonia	10,000 lbm	40 CFR 68
Aqueous Ammonia >20%	10,000 lbm	40 CFR 68
Anhydrous Ammonia	10,000 lbm	29 CFR 1910.119
Aqueous Ammonia >44%	15,000 lbm	29 CFR 1910.119

The proposed storage quantity for the Bull Run SCR system (30,000 gallons per tank or 144942 lbm) would exceed threshold quantities. In addition to on-site storage, anhydrous ammonia must be transported to the plant site to replenish system storage. The use of railcars with a capacity of 124,919 L (33,000 gallons) or trucks with a capacity of 27,249 L (7,200 gallons) would be the mode of transportation.

Risk Factors

The risk and potential severity of an ammonia storage or handling accident would be influenced by a number of factors including:

- Design of the ammonia storage and handling facility including engineered features and safeguards, and the quantity of ammonia stored
- Transportation mode for ammonia deliveries—rail or truck, and the frequency of deliveries (see **Transportation**)
- Procedures for normal operations
- Training of operations personnel for normal operations and emergency response
- Population distribution in the plant vicinity
- Emergency planning and response procedures
- Probability of events such as earthquakes and tornadoes that could initiate a worst case release.

Engineered Features and Safeguards

Properly engineered features and safeguards as well as adequate operating and maintenance procedures and training should make accidents unlikely and limit their consequences. Adherence to standards such as CGA G-2.1 or OSHA 29 CFR 1910.111 would result in safe equipment design. Compliance with 40 CFR 68 and adherence to 29 CFR 1910.119 ensures the use of proper hazard assessment, operating procedures, employee training, and emergency planning.

A primary feature for limiting the potential hazard from an ammonia leak would be a water deluge (fogging) system with both automatic and manual actuation to protect both the storage tank area and unloading area. A deluge system applies a fog blanket of small water droplets to wash ammonia vapor from the air, combining with the ammonia to form liquid aqueous ammonia which would be contained within a compacted earth berm surrounding the ammonia loading and storage facility. This would prevent uncontrolled discharge of aqueous ammonia to surface waters that is detrimental to aquatic life.

To be effective, a deluge system must, at a minimum, deliver a uniform spray of fine droplets over the surface of an ammonia spill at a rate that exceeds the mass transfer (boil-off) of anhydrous ammonia by a factor of at least 3.5. This accounts for the fact that a saturated aqueous ammonia solution at 100° F (summer design condition) is about 29% ammonia by weight. Thus, 3.5 pounds of water must be combined with each pound of ammonia vapor boiling off of a spill to simply achieve a saturated solution. The deluge system would limit the impact of an ammonia leak, but may not entirely mitigate the impact on surface water of the worst-case failure of a storage tank or other catastrophic release. Because of the low probability of a worst case failure, this impact is not considered significant.

<u>Accidental Release of Anhydrous Ammonia</u>

Potential causes for accidental releases of ammonia include worst case release scenarios such as railcar failure, storage tank failure, or tanker truck failure, and alternate release scenarios such as tank leaks and process line leaks. Railcar failure could result in the release of up to 33,000 gallons. The sudden failure of a storage tank could result in the release of up to 30,000 gallons. The sudden failure of a tanker truck could result in the release of up to 7,200 gallons of ammonia. Alternate release scenarios include events with a higher likelihood of occurrence, but much smaller volume of released ammonia. A ¼-inch diameter hole in a storage tank or tanker truck, such as rupture of a gasket or a pump seal leak, could release about 3600 pounds of ammonia at a release rate of 2120 pounds per minute for 30 minutes. A leak from a 2-inch diameter hole in the storage tank or tanker truck, such as transfer hose failure or sudden uncoupling, could cause a release of 2380 pounds of ammonia at a release rate of 238 pounds per minute for 10 minutes. A leak in the supply line connecting the storage tanks to the vaporizers, caused by a 2.5-inch diameter hole, could release 1270 pounds of ammonia at a rate of 254 pounds per minute for 5 minutes. The durations of these tank leaks and process line leaks are based upon the assumed time required for employees to isolate and contain the leak.

The larger releases of ammonia, such as by railcar failure or storage tank failure, could be caused by a major earthquake or a tornado. To judge the risk of these accidents, the probability of major earthquakes and tornadoes were evaluated.

Evaluation of Seismic Hazard

The primary source of earthquake hazard to the BRF site is the East Tennessee Seismic Zone (ETSZ). The ETSZ is located in the southern Appalachians and extends from northeastern Alabama to southeastern Kentucky (Appendix C, Figure C-1). The ETSZ is a persistent source of small magnitude earthquakes; however, the largest historical earthquake in this zone had a magnitude (m_{bLg}) of only 4.6. Typically, earthquakes must have magnitudes of 5.0 or greater to cause significant damage.

The BRF site is underlain by sedimentary rocks of Cambrian and Ordovician ages. The unconsolidated material overlying bedrock can be divided into two categories: (1) alluvial clays, silts, sands, and gravels, and (2) a regolith of residuum and saprolite (Julian and Danzig 1996). Earthquake induced liquefaction is very unlikely at this site, and could only occur in the alluvial sediments, if at all. If any structures will have foundations in soil, geotechnical data will need to be acquired to determine the seismic site category. Structures founded in competent rock at this site are expected to have foundation conditions corresponding to seismic site category A or B (ICBO 1997).

The earthquake hazard at the BRF relative to other locations in the United States is moderate (zone 2A) based on the 1997 Uniform Building Code (ICBO 1997). The U.S. Geological Survey (1996) recently conducted probabilistic seismic hazard mapping for the United States. Appendix C provides the details of the U.S. Geological Survey (1996) results and includes a more complete description of the geologic and seismologic conditions at the BRF. As described in Appendix C, at a frequency of 1.0 Hertz, the ground should shake with a force of at least 6.0% g once in 475 years (g is the acceleration of a falling object due to gravity). The 475 year return period is equivalent to a 1 in 10 chance that the ground shaking will be exceeded in only 50 years.

The earthquake hazard to ordinary buildings at the proposed project site will be addressed through adherence to the seismic provisions of the Uniform Building Code (ICBO 1997). Special structures that house hazardous processes or sensitive equipment may require additional considerations. Transport of hazardous substances, for example, ammonia, through underground or aboveground piping may also require special designs and careful siting to address seismic hazards.

Evaluation of Tornado Risk

There are excellent records of the occurrence of tornadoes in populated areas of the United States. Once source used for nuclear plant siting applications is the “Tornado Climatology of the Contiguous United States” (NRC 1986). To determine the probability of a tornado affecting BRF, a study area was defined as a box of one degree of latitude by one degree of longitude containing the county (84°W, 85°W, 36°N, and 37°N). This resulted in a study area of approximately 3,836 square miles, which is equivalent to a square with sides about 63 miles in length.

The average tornado path affects an area or 2.82 square miles (Thom 1963). As an example this would be the equivalent of a tornado with a path width of 0.25 miles and a travel distance of 11.82 miles (0.25 miles x 11.28 miles = 2.82 square miles). For the study area, **32** tornadoes occurred during the 30 year period 1954-1983. This results in a tornado frequency of 1.07 tornadoes per year (32 tornadoes/30 years = **1.07** tornadoes/year). The annual probability of affecting a particular site in the study are, such as BRF may be calculated as follows:

Annual point probability =
= (1.07 tornadoes/year)*(2.82 sq. miles mean tornado path area)/(3836 sq. miles total area)= $\mathbf{7.9 \times 10^{-4}}$ per year.

In other words, there is a 0.079% chance each year of a tornado affecting a particular site in the study area. This is less than one-tenth of one percent chance per year. Another way to express risk is to calculate how often, on the average, a tornado may affect a particular site. This may be calculated by:

Recurrence interval = 1 year/7.9×10^{-4} = 1 occurrence per **1266 years**.

So on average, a tornado would be expected to affect a site in the study area, such as Bull Run Fossil Plant, once every 1, 250 years. Additionally, the probability of Class F stability occurring is about 0.1 to 0.15, although occurrence immediately after a tornado is unlikely and therefore much lower. The resulting probability of both a tornado and Class F stability in the study area is about 1×10^{-4}.

In summary, the risk of a worst case release and related impacts are considered minimal based on the following factors:

- Development of a Risk Management Plan (RMP) in Compliance with 40 CFR 68 and 29 CFR 1910.119.
- Low probability of a tornado or major earthquake.
- Commitment to earthquake resistant design of the ammonia storage facility.
- Low probability of Class F atmospheric stability coincident with a catastrophic tank failure.

Wetlands

Resource Description

National Wetland Inventory (NWI) maps indicate forested, scrub-shrub, and emergent wetlands occur in the general vicinity of BRF. These areas are associated with Melton Hill Lake, Wolf Creek, and Bull Run Creek. Various species of resident and migratory waterfowl, wading birds, shorebirds and marsh birds use these habitats regularly during various seasons. Except for some species of marsh birds (e.g. Virginia rail, sora), most of these are common and widespread in their distribution.

There are numerous ponds at Bull Run for water treatment that may in part be wetlands. These ponds include coal yard drainage basins, flyash ponds, metal cleaning waste ponds, coal wash refuge fines pond, sludge ponds, and others. However, because these wetland areas are a part of the plant wastewater treatment system, none of these treatment units are classified as jurisdictional wetlands falling under the Clean Water Act.

Potential Impacts

There are no jurisdictional or non-jurisdictional wetlands at the proposed locations of the SCR reactors and the ammonia storage tanks, therefore neither the action nor the no action alternatives would have impacts on wetlands. No wetlands would be disturbed by construction activities and trenching associated with piping for the project and no operational impacts to wetlands from accidental ammonia releases would occur.

Significant Managed Areas:

Resource Description

A review of the TVA Natural Heritage database indicates that the proposed project at BRF is not located in or immediately adjacent to a managed area. There are thirteen managed areas and several ecologically significant sites within five miles of the project site:

> There are fifteen ecologically significant sites that occur on Melton Hill Reservation, located 0.5 to 5.0 miles from the project site. Each of these sites contains state-listed endangered and/or threatened plants, which may make the site suitable for protection. The sites are owned by TVA.
>
> Haw Ridge Park is located 0.25 miles southwest of the project site. Chestnut Ridge Park is located 0.75 miles west of the project site. Oak Ridge Municipal Park is located 1.75 miles northwest of the project site. These parks are owned and managed by the Recreation and Parks Department, City of Oak Ridge. The parks provide public recreation opportunities.
>
> Bull Run Park is located 1.0 miles southeast of the project site. Brushy Valley Park is located 1.75 miles northeast of the project site. Lost Bottom Park is located 3.0 miles north of the project site. These parks, located on Melton Hill Reservation, are owned and managed by Anderson County Conservation Board under license from TVA. The parks provide public recreation opportunities.
>
> Oak Ridge Forest/University of Tennessee Forestry Experiment Station is located 1.25 miles west of the project site. This 2260-acre area is owned and managed by the University of Tennessee, primarily for environmental education. University of Tennessee Arboretum/Wildlife Observation Area is located 2.25 miles southwest of the project site. The arboretum, a 250-acre research and educational facility and nature sanctuary, is a portion of Oak Ridge Forest.
>
> Anderson County Wildlife Sanctuary is located 2.0 miles northwest of the project site. As recently as 1996, this area was owned by Anderson County and managed by Clinch River Environmental Studies Organization. Its purpose was ecological research involving students. It is unknown who owns or manages the area at this time.
>
> Oak Ridge State Wildlife Management Area is located 2.5 miles southwest of the project site. This 37,000-acre area is managed by Tennessee Wildlife Resources Agency for wildlife and hunting. The area lies mostly within Oak Ridge Reservation (see below) and is primarily owned by the U.S. Department of Energy.

Worthington Cemetery Cedar Barrens TVA Ecological Study Area is located 3.0 miles northwest of the project site. This 26-acre site is managed cooperatively between TVA and the City of Oak Ridge, primarily for archaeological and biological resources. The site lies on Melton Hill Reservation and is owned by TVA.

Oak Ridge Barrens Preserve/Oak Ridge Barrens Registered State Natural Area/Oak Ridge Barrens Protection Planning Site is located 3.75 miles west of the project site. This 22-acre site is owned by the City of Oak Ridge. The site is registered with Tennessee Department of Environment and Conservation. The site is also a Tennessee Protection Planning Site. PPSs are compiled by the Tennessee Protection Planning Committee, a cooperative effort of government land managers and private individuals knowledgeable about the biota of the state.

Oak Ridge National Laboratory Reservation/Oak Ridge National Laboratory Lands Potential National Natural Landmark is located 4.25 miles southwest of the project site. This approximately 25,000-acre area is owned and managed by the U.S. Department of Energy, primarily for ecological research and commercial forest management. The National Natural Landmark (NNL) program was established in the 1970s by the National Park Service to identify nationally significant examples of ecologically pristine or near pristine landscapes. This tract, while meeting the criteria for listing, was never registered as a NNL.

Potential Impacts

Although there are several managed areas and ecologically significant sites near the proposed project at BRF, none are in immediate proximity to the plant. Therefore, no impact from either the action or no action alternatives is anticipated because of the distance from the project site.

Terrestrial Ecology

Resource Description

The area in and around the BRF has been heavily impacted and altered as a result of the construction and normal operations of the facility. No natural landscape remains and vegetated areas, where present, are maintained by mowing and other routine landscape techniques.

Potential Impacts

Under the No Action Alternative direct impacts to the existing terrestrial ecology would be insignificant. Indirect impacts to the existing terrestrial ecology, as a result of the continuous production of NO_X, would continue. Because the proposed project lies entirely within the fossil plant proper both direct and indirect impacts to the terrestrial ecology will be insignificant, and possibly beneficial, on both a local and regional level.

Threatened or Endangered Species

Resource Description

Plants

Several Tennessee state-listed and no federally listed plant species are known to occur within five miles of the BRF. However, habitat for such species is not likely to be present on or adjacent to the project area

Terrestrial Animals

Five rare terrestrial animal species and three sensitive areas, have been documented in the vicinity of the project area. None of these species have federally protected status. The rare species reported from the area include southeastern shrew (*Sorex longirostris*), grasshopper sparrow (*Ammodramus savannarum*), barn-owl (*Tyto alba*), osprey (*Pandion haliaetus*) and eastern hellbender (*Cryptobranchus alleganiensis alleganiensis*). A heron colony and two caves are located in excess of one mile from the project location.

The eastern hellbender has been reported 0.3 miles from the proposed construction activities, within Melton Hill Reservoir. The remaining rare species were reported in excess of 3 miles from the project site. No suitable habitat for any of these species would be present on the areas proposed for construction or demolition activities.

Aquatic Animals

Before Melton Hill Reservoir was constructed, this part of the Clinch River supported populations of several native mussel and fish species that are now protected as federal or state endangered or threatened species. Habitat conditions in the reservoir are no longer suitable for these species and there are no recent records of federal- or state-listed aquatic animals from the project area. No species with protected status are known from the Worthington Branch which flows through the BRF site.

Potential Impacts

Because the proposed project lies entirely within the existing fossil plant and because no rare plants are known from the vicinity, no impacts to federally or state-listed rare plant species or sensitive habitats are anticipated as a result of either the No Action or Action alternatives. Due to the distance between the project area and reported localities of rare terrestrial animals, and because construction activities would be limited to the BRF properties, construction of the SCR system would not result in adverse impacts to these rare species or their habitat. Because no endangered or threatened aquatic animals are known from the project area, the proposed project would not result in any adverse impacts to protected aquatic animals.

Floodplains

The BRF is located at Clinch River mile 48.0 on Melton Hill Reservoir in Anderson County, Tennessee. At this location the 100- and 500-year flood elevations would be 797.3 and 798.1 feet mean sea level, respectively. Under Executive Order (EO) 11988, an ammonia facility would be considered a “critical action” because flooding of the facility would create an added dimension to a flood. Based on the location maps, the site for the ammonia facility is located outside the limits of the 100-year floodplain and above the 500-year flood elevation which would comply with EO 11988.

Land Use, Visual Aesthetics, and Noise

Resource Description

The plant site is bordered by wooded ridges on the north and south, a partially-wooded valley to the east, and the Clinch River on the west. There is residential development in the valley and on the ridge to the north. The partially-wooded hills across the river are undeveloped federal properties used for informal recreation. Edgemoor Road bridges the river, and borders the site on the north side along the base of the ridge. The existing plant facilities provide a significant visual contrast to the surrounding rural landscape. They include large scale industrial structures and operations that are seen above trees and across open areas. The facilities are visible to passing motorists, boats on the river, and homes in the area. The SCR systems would be installed near the main plant buildings in an area that is committed to industrial use and exhibits noise levels typical of a power plant industrial facility.

Potential Impacts

The proposed SCR, ammonia, and construction features would be located primarily in the plant area, adjacent to existing facilities. Since these locations are used intermittently for related industrial purposes, the land use would not change. The proposed additions would cause no significant visual change to this industrial site. Although some details would be different than currently seen, the overall character would appear the same. The SCR facilities would be of similar scale and appearance to adjacent structures. The northern-most SCR may be seen by passing motorists, but visual continuity with existing features would make these additions hardly noticeable. The ammonia storage facilities would be similar in scale and visual character to the near-by storage buildings and yards. From elevated viewpoints the near-by residents and motorists would see these facilities just south of several transmission towers. When viewed by motorists at driving speed, the additions would visually blend into the passing industrial landscape.

Existing facilities would screen most construction activities and laydown areas from public view. These activities, materials, and equipment would temporarily add minor visual discord on site. Some taller equipment may be visible to passing motorists during the construction period.

No unusual changes or noticeable increases in plant noise are anticipated for the proposed action as compared to those existing under the no action alternative. For the action alternative there would be temporary and minor noise increases during construction activities. Operation of the booster fans at a higher speed and power, operation of the new ammonia transfer pumps, continued operation of the air dilution fans and minor increases in truck traffic for delivery of ammonia would marginally increase the noise level. However, these should be minor sources of noise and not noticeable to the public.

Archaeological and Historic Resources

Resource Description

East Tennessee has been an area of human occupation for the last 12,000 years. Human occupation of the area is generally described in five broad cultural periods: Paleo-Indian (11,000-8,000 BC), Archaic (8000-1600 BC), Woodland (1600 BC-AD 1000), Mississippian (AD 1000-1700), and Historic (AD 1700- to present). Prehistoric land use and settlement patterns vary during each period, but short- and long-term habitation sites are generally located on flood plains and alluvial terraces along rivers and tributaries. Specialized campsites tend to be located on older alluvial terraces and in the uplands. European interactions with Native Americans in this area began in the 17th and 18th centuries associated with the fur trading industry. Anderson was established in 1801 and remained rural throughout the nineteenth and early twentieth centuries (Mielnik 1998). In the early twentieth century the establishment of TVA and Oak Ridge changed the landscape of the county making it more urban.

At least 12 archaeological sites have been recorded within 1 mi. of the BRF. These sites include prehistoric and historic period habitation sites. No systematic survey of the BRF has been conducted and no sites have been recorded within the plant area. The plant is highly disturbed in most areas, including the footprint areas for the proposed SCR system. No archaeological resources occur in the area of effect of the SCR system because of previous disturbance of the proposed construction sites.

Nine historic properties and three historic districts are listed on the National Register of Historic Places within Anderson County. The J.B. Jones House is located within 2 mi. of the Bull Run Fossil Plant on the opposite side of the Melton Hill Lake.

Potential Impacts

Due to the highly disturbed nature of the project area, it is TVA Cultural Resources staff's finding that no historic properties will be affected by either the no action or action alternatives. There are no historic structures within the plant site because all plant structures were constructed less than 50 years ago. The J.B. Jones House will not be visually or directly affected by this project. The Tennessee SHPO concurs with TVA's finding that there will be no affect on historic properties (Appendix B).

Solid and Hazardous Waste—Coal Combustion By-Product (CCB) Generation, Marketing and Handling

Existing Conditions

BRF is expected to burn between 2.0 and 2.2 million tons of coal annually through at least 2014. The coal averages 9.59% ash, therefore, total ash production will range from approximately 191,000 to 210,000 tons of ash per year. The ash is collected as either fly ash, which is fine enough and light enough to be carried with the flue gas stream exiting the boiler or as bottom ash which is coarser and heavier and falls to the bottom of the boiler. The fly ash/bottom ash split is about 85% fly ash and 15% bottom ash.

Fly Ash

The fly ash handling system at BRF was converted to a dry fly ash handling system. Prior to this, all fly ash and bottom ash was sluiced to the ash pond complex. Since the conversion, fly ash which is separated from the flue gases in electrostatic precipitators and collected in hoppers is pneumatically collected dry and blown to a single 1900 ton fly ash silo. Fly ash which meets industry specifications is marketed for readymix concrete or other products can be delivered into pneumatic tanker trucks from the silo which is equipped with a dry unloader. Fly ash which does not meet specifications and/or which is not marketed can be conditioned with water in pug mills located near the bottom of the silo and loaded into dump trucks for transport to the fly ash disposal or utilization areas. Fly ash production is expected to range from about 150,000 to 190,000 tons per year, depending on coal burn, through 2014.

Although BRF collects most of the fly ash dry, it retains the capability to sluice fly ash to the ash pond complex. Fly ash is sluiced during unit start-up and during operational problems that compromise the reliability of the dry fly ash collection system. In recent years, BRF has sluiced as much as 70,000 tons of fly ash annually to the ash pond.

BRF recently utilized all of the fly ash produced at the plant for development of the Lost Ridge Industrial Park. This project is a structural fill demonstration which will utilize approximately 1 million tons of BRF fly ash over the life of the project. The project was begun in 1993 and was completed in late-2000. BRF also markets small amounts of fly ash for cement replacement in readymix concrete products; however, this market has been sporadic due to variable and/or high carbon content (loss on ignition or LOI) in the fly ash. Due to the LOI variability, TVA has sought to develop markets for BRF fly ash that are not sensitive to LOI variability.

TVA currently has a contract with a private company to supply BRF fly ash to an autoclaved cellular concrete (ACC) pilot plant which is developing a market for this product. The company has a full-scale ACC plant in Georgia to which the ash will be shipped. The ACC plant is capable of utilizing approximately 60,000 tons of fly ash per year initially, and could gradually utilize over 100,000 tons per year as markets are expanded. Material not utilized in the ACC plant will either be marketed for other uses such as readymix concrete products or disposed of in an on-site dry fly ash stacking area which is already permitted on site.

Bottom Ash

Bottom ash collects in the bottom of the boiler and is periodically washed from the boiler bottoms with jets of water and sluiced to a bottom ash dewatering area within the ash pond complex. The bottom ash is removed from this area with pan scrapers and then carried to stacking areas within the ash pond complex. Bottom ash production is expected to range from about 40,000 to 48,000 tons per year, depending on coal burn, through 2014.

Potential Impacts

For the no action alternative no impacts to existing production or use of coal combustion byproducts is anticipated.

Fly Ash

For the action alternative potential impacts of “ammonia slip” or excess unreacted ammonia as a result of the SCR installation could include undesirable levels of ammonia being deposited on the dry fly ash. During operation of the SCR system “ammonia slip” will increase as the catalyst ages. Most of this ammonia will be adsorbed on the fly ash in the form of ammonium bi-sulfate which tends to be a “sticky” molecule. Some of this sticky ash will adhere to the air pre-heaters where it will be removed periodically. Most of the rest of the ammoniated ash will be removed in the electrostatic precipitators and collected in hoppers for pneumatic transport to the dry fly ash silo.

If ammoniated fly ash is sluiced directly to the ash pond complex, the ammonia would dissolve rapidly in the sluice water. The concentration of ammonia in the sluice water would be dependent upon the concentration of ammonia on the fly ash, the amount of fly ash sluiced to the pond, the volume of water sluiced and the volume of water in the ash pond

Fly ash used in ACC manufacturing will be mixed in a slurry tank at the ACC plant and then pumped into tanks for mixing with the lime and cement. At this point in the process the pH of the mixture will rise above 10.0 which will cause ammonia to be released as a gas from the mixing tanks. Excessive ammonia levels on fly ash could cause odor problems in the ACC plant and therefore require special ventilation to alleviate the problem. Once the ACC slurry is mixed and placed in the molds, the cake is cut and cured in autoclaves under high heat and pressure conditions. This heat curing should drive off any residual ammonia from the finished product, so odor should not be a problem in the finished product.

Dry fly ash containing ammonia used in cement replacement and certain other uses can then, in turn, cause ammonia releases from the products when mixed with water or when the concrete products are placed in damp environments like basements or enclosed areas. If ammonia levels are high enough, the ammonia can be irritating to eyes and nasal passages. Ammonia levels on fly ash in excess of 100 ppm are commonly linked to these problems. Generally, at levels below 100 ppm, fly ash can be used without any detectable odor problems. Ammonia odor problems have also been known to occur on fly ash disposal areas when the ash is conditioned with water for disposal or during rainfall events. This can affect worker safety and can be an odor problem for nearby neighbors. At BRF, control of ammonia odors from the dry fly ash stacking area and from the ACC plant could be critical due to the close proximity of residential neighborhoods and traffic on Edgemoor Road. Maintaining the active area of exposed dry fly ash at 10 acres or less and closing stacking areas with an interim cover as they become inactive should aid in adequately minimizing odors.

If current fly ash marketing projections of 60,000-100,000 tons per year can be maintained, the life of the dry fly ash stacking area will be extended from its original 10 year planned life to at least 25 years, or through 2025. If marketing cannot be maintained at these levels, the capacity of the dry fly ash stacking area will be exhausted by about 2010. Since operation of the SCR will be controlled to minimize the ammonia slip, the addition of the SCR is not expected to affect the marketability of the ash. If marketability cannot be maintained, resulting in depletion of existing storage capacity, the existing area would have to be closed and a new dry fly ash stacking area would need to be permitted and developed at least 3 years prior to that time.

Bottom Ash

Although BRF has used some of the bottom ash produced through the end of 1999 to construct plant roadways, dikes, and donates the material to local city and county highway departments for road base construction and snow and ice control, TVA has never marketed significant quantities of bottom ash from BRF. However, TVA expects to begin developing a market for this material within the next year. Bottom ash can be used in block manufacturing and as industrial abrasives. No impacts associated with bottom ash marketing, utilization or disposal have been identified as a result of SCR installation and operation at BRF since the bottom ash is collected in the boiler prior to ammonia injection (Figure 2).

<u>Catalyst Recycling and Disposal</u>

The catalyst for the SCR would be vanadium pentoxide. This chemical falls in a unique class of hazardous waste under the Resource Conservation and Recovery Act (RCRA). The classification is as a listed P120 RCRA waste, which refers only to unused product. If it is a used product (spent catalyst), normal special waste rules apply. Any unused product, other than a *de minimis* amount, must be treated as a hazardous waste. There is also some potential that spent catalyst could have an accumulation of heavy metals found in coal combustion flue gas.

TVA has a catalyst management contract with the catalyst vendor. These services would include acceptance and ownership of spent catalyst by the vendor. If the spent catalyst is classified as a hazardous waste, TVA would have responsibility for proper disposal. It is common practice to recycle the catalyst thus minimizing the need for waste disposal. Should TVA become the custodian of any hazardous waste associated with the catalyst, a qualified hazardous waste disposal facility would be used for ultimate disposal. Spent catalyst handling would likely require respiratory protection of workers to prevent inhalation of dust or fines. The MSDS (Appendix A) for vanadium pentoxide lists a 3 ppm limit for respiratory protection.

Aquatic Ecology

<u>Resource Description</u>

This reach of Melton Hill Reservoir transitions from the upstream riverine reach to the more lacustrine conditions found nearer the dam. Overbank areas near BRF are very shallow. The Bull Run Creek embayment enters the reservoir on the left bank about 1.5 river miles (2.4 kilometers) downstream of the BRF CCW discharge. The dominant factor influencing aquatic resources of Melton Hill Reservoir, especially the upper and mid-reservoir areas, is the cold water entering from Norris Dam discharges. Although warmed somewhat by the BRF discharge, temperatures are still marginally low to support warm water biota and marginally warm to support cold water biota (TVA 1999).

TVA began a program to systematically monitor the ecological conditions of its reservoirs in 1990. Previously, reservoir studies had been confined to assessments to meet specific needs as they arose. Reservoir (and stream) monitoring programs were combined with TVA's fish tissue and bacteriological studies to form an integrated Vital Signs Monitoring program. Vital signs monitoring activities focus on (1) physical/ chemical characteristics of waters; (2) physical/chemical characteristics of sediments; (3) benthic macroinvertebrate community sampling; and (4) fish assemblage sampling (TVA 1999).

Benthic (lake bottom) macroinvertebrate and fish samples were taken in three areas of Melton Hill Reservoir from 1991 through 1994, and again in 1996 and 1998, as part of TVA's Reservoir Vital Signs monitoring program. Areas sampled included the forebay (area of the reservoir nearest the dam), a mid-reservoir transition station in the vicinity of CRM 45.0, and an upper-reservoir inflow station near the U.S. Highway 25W bridge at Clinton. Although other fish species could occur in the vicinity of BRF, results of sampling at the transition station are presented here because they would be most representative of fish and benthic communities in the vicinity of BRF.

Benthic macroinvertebrates are included in aquatic monitoring programs because of their importance to the aquatic food chain, and because they have limited capability of movement, thereby preventing them from avoiding undesirable conditions. Sampling and data analysis were based on seven parameters that indicate species diversity, abundance of selected species that are indicative of good (and poor) water quality, total abundance of all species except those indicative of poor water quality, and proportion of samples with no organisms present. Compared to the transition stations of other TVA run-of-the-river reservoirs, the transition station benthic community rated fair in 1994, 1996, and 1998 sampling, largely because of low total abundance of all species present (TVA 1999).

The Reservoir Vital Signs monitoring program also has included annual fish sampling at Melton Hill from 1990 through 1994, and in 1996 and 1998. Fish are included in aquatic monitoring programs because they are important to the aquatic food chain and because they have a long life cycle which allows them to reflect conditions over time. Fish are also important to the public for aesthetic, recreational, and commercial reasons. Ratings are based primarily on fish community structure and function. Also considered in the rating is the percentage of the sample represented by omnivores and insectivores, overall number of fish collected, and the occurrence of fish with anomalies such as diseases, lesions, parasites, deformities, etc. (TVA 1999). Compared to other run-of-the-river reservoirs, the fish assemblage at the Melton Hill mid-reservoir station rated poor in 1992, fair in 1990, 1991, and 1996, but good in 1993, 1994, and 1998. Species diversity and abundance are generally not as high as in other run-of-the-river reservoirs. A total of 29 fish species was collected at the transition station in TVA's most recent fish collections in the fall of 1998 (Table 5). More abundant species in the sample were gizzard shad, common carp, and bluegill (TVA 1999).

Melton Hill provides opportunities for sport anglers. A Sport Fishing Index (SFI) has been developed to measure sport fishing quality for various species in Tennessee and Cumberland Valley Reservoirs (Hickman 1999). The SFI is based on the results of fish population sampling by TVA and state resource agencies and, when available, results of angler success as measured by state resource agencies (i.e., bass tournament results and creel surveys). In 1998, Melton Hill rated average for black bass species (largemouth, smallmouth, and spotted bass), but below average for striped bass and bluegill.

Table 5. Fish species collected in 1998 fall electrofishing and gill netting samples at the Melton Hill Mid-Reservoir Transition Station (CRM 45.0).

Common Name	Scientific Name
Skipjack herring	*Alosa chrysochloris*
Gizzard shad	*Dorosoma cepedianum*
Muskellunge	*Esox masquinongy*
Common carp	*Cyprinus carpio*
Central stoneroller	*Campostoma anomalum*
Spotfin shiner	*Cyprinella spiloptera*
Bluntnose minnow	*Pimephales notatus*
Quillback	*Carpiodes cyprinus*
Smallmouth buffalo	*Ictiobus bubalus*
Spotted sucker	*Minytrema melanops*
Silver redhorse	*Moxostoma anisurum*
Golden redhorse	*Moxostoma erythrurum*
Channel catfish	*Ictalurus punctatus*
Yellow bass	*Morone mississippiensis*
Striped bass	*Morone saxatilis*
Rock bass	*Ambloplites rupestris*
Redbreast sunfish	*Lepomis auritus*
Green sunfish	*Lepomis cyanellus*
Warmouth	*Lepomis gulosus*
Bluegill	*Lepomis macrochirus*
Redear sunfish	*Lepomis microlophus*
Smallmouth bass	*Micropterus dolomieu*
Spotted bass	*Micropterus punctulatus*
Largemouth bass	*Micropterus salmoides*
White crappie	*Pomoxis annularis*
Black crappie	*Pomoxis nigromaculatus*
Yellow perch	*Perca flavescens*
Logperch	*Percina caprodes*
Walleye	*Stizostedion vitreum*

Recent Tennessee Wildlife Resources Agency (TWRA) fish collections at Melton Hill indicate relatively low productivity and standing crop. Fluctuating water temperatures due to cold tailwater releases from Norris Reservoir were thought to possibly affect reproductive success and growth rates of warm-water fish species. Although no creel census data is available for Melton Hill, catch rates in TWRA electrofishing samples indicate that largemouth bass provide the major black bass fishery, with older largemouth experiencing slow growth and relatively low mortality. Muskellunge were stocked in 1998, with additional future stocking planned in an effort to create a sport fishery for this cool water species (TWRA 1999).

<u>Potential Impacts</u>

For the no action alternative the existing conditions and trends described for aquatic life in Melton Hill Reservoir are expected to continue.

Construction Impacts

Potential construction impacts to Melton Hill Reservoir would include temporary erosion and siltation resulting from soil disturbing activities during installation of the SCR reactors, ammonia storage and unloading area, interconnecting ammonia and service water piping, electrical conduits, and retention basins. These areas have previously been disturbed by plant construction and modification activities. As incorporated in the Storm Water Prevention Pollution Plan (SWPPP) required to be developed under the General NPDES permit, implementation of Best Management Practice's (BMPs) to control erosion during construction and stabilize disturbed areas after construction is complete would minimize impacts. The introduction of soil into Melton Hill Reservoir could result in temporary inhibition of feeding activities by fish, fish being driven away by gill irritation, and death of smaller and younger fish due to gill clogging. These potential impacts would be avoided or minimized by the use of BMPs during all parts of the construction work. The use of appropriate erosion and sedimentation practices will substantially reduce the potential for impacts in Melton Hill Reservoir or small tributaries, to the point of causing only minor and temporary effects on fish and other aquatic life.

<u>Operational Impacts</u>

Ammonia is very toxic to fish and other forms of aquatic life. Provisions (**See Environmental Commitments**) have been made for containment of accidental spills from storage tanks. During routine operations at BRF, establishment of appropriate effluent toxicity limits, combined with monitoring of the ash pond and condenser cooling water discharges, will result in insignificant impacts to aquatic life that use tributaries and adjacent areas of Melton Hill Reservoir for spawning or feeding. These operational and treatment controls would be specified in the NPDES permit for the facility.

WASTEWATER

<u>Existing CCB Wastewater Treatment Facilities</u>

As described below, the coal combustion by-products (CCB) handling system utilizes a number of areas which receive and treat wastewater effluents including the ash pond and the bottom ash storage area and bottom ash pond.

Ash Pond

BRF is expected to burn between 2.0 and 2.2 million tons of coal annually through at least 2014. The coal averages 9.59% ash; therefore, total ash production will range from approximately 191,000 to 210,000 tons of ash per year. The ash is collected as either fly ash, which is fine enough and light enough to be carried with the flue gas stream exiting the boiler or as bottom ash which is coarser and heavier and falls to the bottom of the boiler. The fly ash/bottom ash split is approximately 85% fly ash and 15% bottom ash.

Fly ash production is expected to range from about 150,000 to 190,000 tons per year. The fly ash handling system at BRF has been converted to a dry fly ash handling system. Prior to this, all fly ash and bottom ash was wet sluiced to the ash pond complex Since the conversion, fly ash, which is separated from the flue gases in electrostatic precipitators and collected in hoppers, is collected dry and pneumatically transported to a single 1,900 ton fly ash silo.

Dry fly ash that is not marketed can be conditioned with water and loaded into dump trucks for transport to the fly ash disposal or utilization areas. The maximum active area of exposed dry fly ash will be 10 acres or less (Robinson 2000). As stacking areas become inactive, they will be closed with an interim cover. The dry fly ash stack is graded to a 1% to 2% slope at the end of each day to limit ponding and encourage sheet flow runoff. Runoff from the dry fly ash stacking area drains to a sedimentation pond where it evaporates or overflows into the coal storage yard pond which is manually pumped to the ash pond as needed (Ross 2000).

BRF also retains the capability to sluice fly ash to the ash pond complex. Fly ash is sluiced during unit start-up and during operational problems which could compromise the reliability of the dry fly ash collection system. In recent years, as much as 70,000 tons of fly ash has been sluiced to the ash pond annually.

About 16.7 MGD is discharged from the ash pond through NPDES Outfall 001. Outfall 001 discharges to Clinch River mile 48. The pH of the ash pond discharge generally ranges from 7.1 to 8.8. In the plant NPDES permit TVA is required to meet pH, oil and grease, heavy metals, toxicity, and total suspended solids limits on ash pond discharge. These requirements currently do not include limitations for ammonia. The ash pond currently receives waste water from a number of sources as shown in Table 6.

Bottom Ash Pond

Bottom ash collects in the bottom of the boiler and is washed from the boiler bottoms with jets of water and sluiced to a bottom ash dewatering area within the ash pond complex. Dewatered bottom ash is removed from these cells with pan scrapers and then carried to storage areas within the ash pond complex. Bottom ash production is expected to range from about 40,000 to 48,000 tons per year, depending on coal burn, through 2014. Installation of the SCR system would not be anticipated to affect the operation of the bottom ash pond or bottom ash storage areas since the bottom ash is collected in the boiler prior to the point where ammonia would be injected.

<u>Potential Impacts</u>

Under the no action alternative, no ammonia would be added to the water wastestream. Current water quality of the BRF discharge at all outfalls would be expected to be maintained. All NPDES requirements would continue to be met.

Construction Impacts from Surface Runoff

For the action alternative all construction activities would be within the existing plant site. Surface runoff that flows to the ash pond is currently permitted. Construction related runoff that discharges directly to surface waters may require an NPDES General permit. The general permit would require TVA to develop a SWPPP. Using appropriate BMPs contained in the SWPPP, all construction activities would be conducted to ensure that waste materials are contained and that no polluting materials are introduced into receiving waters.

Table 6. Inflow Sources to the Ash Pond (NPDES permit 1999).

Source	Inflow to Ash Pond (MGD)
FD fan cooling water	1.512
Dry fly ash washdown sump	0.012
Boiler bilge sump	1.718
Flows from the Chemical Treatment pond	0.0032
Boiler fireside washing	0.0038
Ash sluice water	9.805
Precipitator pad washdown sump	
Precipitator area washing	0.005
Reject water - treatment plant	0.050
Condensate polisher wastes	0.002
Stack yard sump	
Equipment cooling water	0.780
Floor washing wastes	0.019
Main station sump	
Equipment cooling water & leakage	2.139
Floor washing wastes	0.019
Plant leakage (boilers)	0.089
Roof drains	0.0086
Ash sluice line low point sump	
Yard runoff	0.0137
Back parking lot runoff	0.0052
Electrical yard runoff	0.011
Unwatering sumps	
Yard runoff	0.0038
Emergency overflow from main station sump	0
Runoff coal yard pumping basin	
Coal storage area	0.145
Fly ash stacking area NE of coal yard	0.112
Runoff from ash stacking area	0.064
Direct precipitation onto ash pond	0.373
Evaporation from ash pond	-0.145
Total	16.7483

Construction Workforce Domestic Sewage Disposal

Portable toilets would be provided for the construction workforce. These toilets would be regularly pumped out and the sewage transported by tanker truck to a publicly owned treatment works accepting pump out.

Operational Impacts from Wastewater Management of Ammonia Slip

Excess ammonia (or ammonia slip) that does not react with the NO_x in the flue gases will pass through the SCR system. The amount of ammonia slip will depend on unit operation, the amount of ammonia injected and the time the catalyst has been in service. A 2.0 ppmv slip would be the operating condition and would result in a total ammonia load of 7.97 pounds per hour. Catalyst efficiency is non-linear and is spent gradually over the lifespan of the catalyst.

The ammonia (as NH_3) will react with the SO_3 in the flue gas to form ammonium bisulfate. Sufficient SO_3 will be available to react with all of the NH_3. The resulting ammonium bisulfate would have the following fates: 1) adhere to the fly ash which is either marketed, dry stacked, or sluiced; or 2) adhere to the APH elements and be removed by periodic cleaning.

According to a study conducted by ABB Environmental Systems (now Alstom), about 20% of the NH_3 slip is precipitated onto the heating surfaces in the APH, and about 80% of the ammonia adheres to the fly ash (Influence of NH_3 in Fly Ash and Gypsum, ABB Environmental Services 1999). The worst case studies conducted for this EA assume that the unit has just reached 2ppmv slip, and that 100% of the slip will have the potential to enter the waste water stream. Similar to the ABB study, the worst case analysis for this EA assumes that 80% of the ammonia is removed with the dry fly ash and 20% adheres to the APH elements.

Ammonia build up on the APHs occurs constantly when the unit is in operation and ammonia is being injected. There is potential for a concentrated slug of ammonia to enter the waste water stream when the APHs are washed. More ammonium bisulfate adheres to the APH elements the longer the interval between washings, in effect, increasing the ammonia load released during a wash.

APHs at BRF are ordinarily washed every 18 months offline. BRF does not have the capability to wash APHs while online, but there are plans to install new APHs during the same outage as for the SCR installation (Elder 2000). The new heaters will most likely use a combination cleaning nozzle that is capable of using steam or air. The APHs will also be equipped for high pressure water washing. The current plans are to water wash off-line since online washing promotes acidic corrosion and thermal distortion problems. The highest shock loads of ammonia to the waste water stream would occur if all 4 APHs in the unit were washed during an outage. The worst case APH wash scenario analyzed for this EA conservatively assumes 4 APHs are washed, each with an average 18 month build up of ammonium bisulfate at the end of the catalyst's life cycle (maximum slip just before catalyst is replaced). No losses of ammonia through volatilization or chemical reaction were assumed. Steady release of the ammonium bisulfate material throughout the washing process was assumed although it is possible that a more concentrated release of the material may occur over a shorter time span during the washing process. Actual data on the effects of SCR's on APH operation and resulting ammonia concentrations in APH wash water was unavailable.

Soot blowers are used at least every 4 hours to keep the APHs unplugged. A portion of the ammonium bisulfate build up on the APHs would be removed in this process. The ammonium bisulfate removed by the soot blowers is expected to end up in the fly ash collected in the precipitators. For this analysis, it was assumed that the soot blowers regularly removed about 10% of the ammonium bisulfate. It is unknown how effective the soot blowers will be at removing the material, but if the percentage is lower than the estimated 10%, the average interval between APH washings will decrease based on the APH differential pressure. Under the worst case scenario an estimated 7,247 pounds of ammonia are expected to be washed out of the APHs and eventually loaded to the ash pond as a result of washing all four APHs after an 18 month interval between APH washings.

The worst case APH washing scenario, analyzed for this EA, is summarized below:

- At a 2ppmv slip the ammonia load is estimated to be distributed as follows: approximately 1.59 pounds per hour per unit to the APHs and approximately 6.38 pounds per hour to the fly ash.
- The unit has just reached a 2ppmv slip.
- The unit is offline during a planned outage, and all 4 APHs are being washed.

For completeness and a truly worst case scenario, this section assumes that all ammonia goes into the wastewater. Infiltration and seepage by rainfall from the dry stacking area is analyzed independently in the groundwater section of this assessment.

Ammonia in the dry fly ash has potential to enter the waste water stream either during a rainfall event as runoff from the dry fly ash stacking area flows into the ash pond or when fly ash is sluiced to the ash pond. For the worst case fly ash analysis, it was assumed that a rainfall event generated runoff from the fly ash stacking area. It was assumed that the exposed surface area of the stack had just reached maximum capacity before being covered. The concentration of ammonia in the fly ash was 164 mg of ammonia per kg of fly ash, and all of the ammonia stored in the top 1 inch of the stack would be released into the sedimentation basin. The runoff which is held-up in the sedimentation basin overflows into the coal yard runoff pond. The coal yard runoff pond has the ability to pump manually and should be done so over a period of 5 days for this worst case scenario. Little data is available to estimate the concentration of ammonia in the fly ash or to estimate the amount of ammonia that will run off during a rain event. Much of this data will be plant specific. To limit ammonia loads from the dry fly ash stack, it would be important to restrict the amount of dry fly ash exposed to 10 acres or less. The greater the surface area of exposed dry fly ash, the more ammonia is available to runoff during a rain event. In a more likely scenario, the sedimentation basin that collects the dry stack runoff will not overflow into the coal yard runoff pond; it will simply remain there until it evaporates.

The worst case dry fly ash stacking area scenario analyzed for this EA is summarized below:

- At a 2ppmv slip the ammonia load is estimated to be distributed as follows: approximately 1.59 pounds per hour to the APHs and approximately 6.38 pounds per to the dry fly ash.
- The unit has just reached a 2ppmv slip.
- A rainfall event generated runoff from the dry fly ash stack which has just reached maximum capacity before being covered.
- The sedimentation basin containing the dry stack runoff overflows into the coal yard runoff pond which in turn is discharged to the ash pond over a 5 day period.

Table 7 gives the expected effluent concentrations of the ash pond, using the worst-case scenario. The effluent concentrations that were calculated assume there are no losses of ammonia through chemical reaction, settling, or volatilization. The worst case scenario shows the ash pond Outfall 001 discharge concentration is approximately 0.60 mg/L of ammonia as nitrogen.

Table 7. Potential Ammonia Nitrogen Concentrations at Outfall 001.

Condition	Worst Case NH_3 Load (pounds)	Eff. Conc. Of in mg NH_3-N/L[1] Ash Pond Discharge (Outfall 001); 100% unit fly ash sluice at unit start-up/shut-down	Eff. Conc. Of in mg NH_3-N/L[1] Ash Pond Discharge (Outfall 001); **5 day** staging coal yard runoff pond	Eff. Conc. Of in mg NH_3-N/L[1] Ash Pond Discharge (Outfall 001); **50 day** staging of chemical treatment pond
Wet sluicing at startup/shut down	153	0.45		
Dry Fly Ash Stacking Area[2] Runoff	546		0.32	
Air Preheater Wash[3]	7247			0.43
Background Concentration		0.15	0.15	0.15
Total Outfall 001 Concentration		0.60	0.47	0.58

[1]Based on existing background NH_3-N concentration of 0.15 mg/L
[2]Air preheater was water limited to discharging chem. Pond ammoniated water over 5 days. Calculation based on mixing in the ash pond = 40.5 million gallons.
[3]Air preheater wash water limited to discharging coal yard pond ammoniated water over 50 days. Calculation based on mixing in the ash pond - 40.5 million gallons.

To avoid too high ammonia concentrations at Outfall 001, the three potential sources of ammonia to the ash pond (ash sluicing, APH wash water via the chem. pond, and dry stack runoff via the coal yard runoff pond) should be released to the pond singularly as reflected in Table 7.

The outfall concentrations in Table 7 are achieved by mixing input from the ammonia sources with the ash pond Free Water Volume (FWV). Currently the water traveling through the ash pond is not utilizing the FWV. Instead it is short circuiting towards the outfall in less than 12 hours. To meet the concentrations in Table 7, it will be required to baffle the pond, increasing the retention time closer to the theoretical time of 2.4 days, to achieve proper mixing and pond dynamics.

Following an APH wash, some treatment of the wash water would be required if it is necessary to achieve a chemical treatment pond effluent concentration below 0.43 mg NH3-N/L. Conventional ammonia treatment measures such as pH adjustment, air stripping, and re-circulating sand filters could be employed to remove ammonia from the pond prior to discharge.

The Air Preheater Wash With Treatment scenario shown in Table 7 was achieved by limiting the ammonia load to the ash pond to 0.43 mg NH3-N/L through an operational treatment measure - staged discharge of the APH wash water. Staged discharge of the

APH wash water can be attained by slowly releasing the wash water from the chemical treatment pond to the ash pond over several days. This offers reduction of ammonia in the ash pond effluent to a maximum effluent concentration of 0.58 mg NH3-N/L.

To accomplish the reduced concentrations, the worst case APH washing scenario (washing four APHs) should be manually discharged over 50 days. When washing just one APH instead of four, staged discharge could occur over 13 days. At slips lower than 2ppmv, ammonia loads decrease and staging can occur over a shorter duration as shown in Table 8.

Table 8. Number of Days Required to Discharge Air Preheater Wash Water into Ash Pond and Maintain 0.60 mg/L NH_3 - N Effluent Concentration or Less[1].

	4 Air Preheaters Washed	1 Air Preheater Washed
Slip = 0.5 ppmv	13 days	3 day
Slip = 1.0 ppmv	25 days	6 day
Slip = 2.0 ppmv	50 days	12 days

[1]Based on existing background NH_3-N concentration of 0.15 mg/L, ash pond volume - 40.5 million gallons. Steady discharge of ammonia throughout the washing process.

It will be important to ensure that there is enough available volume in the chemical treatment pond to hold and slowly release the APH wash water as prescribed above. The chemical treatment pond may need to be pumped before an APH washing to hold the wash water. A typical 4 APH wash uses approximately 1 million gallons of wash-water (Ross, January 2000).

The coal yard runoff pond will collect the overflow from the dry stack runoff retention basin. The coal yard runoff pond can be manually pumped and should be staged in accordance to Table 7 to maintain the necessary concentrations at Outfall 001.

There are currently no requirements to monitor ammonia nor is there an ammonia discharge limit for Outfall 001. There are toxicity limits on Outfall 001. The ammonia discharge limit necessary to meet toxicity requirements would be a function of pH and temperature. For example, the ammonia concentration to protect from chronic, sub-lethal effects to aquatic life is 6.6 mg N/L at pH 6.5 and 4.6 °C (low end of ash pond pH and intake temperatures measured in 2000) and 1.1 mg N/L at pH 8.3 and 19.6 °C (high end of ashpond pH and intake temperature measured in 2000). Table 7 shows that the ammonia concentrations projected for Outfall 001 under worst case scenarios and with treatment of the APH wash are below the maximum allowable concentrations for protection of aquatic life under typical operating conditions. There could be some increase in the pH of Outfall 001 due to increased phytoplankton productivity in the ash pond if nitrogen is currently a limiting nutrient. Any reduction in ammonia or pH necessary to meet WET or other limits would be met by necessary operational and treatment measures in the ash pond.

Whole Effluent Toxicity

Discharge from Outfall 001 is regulated under NPDES Permit No. TN0005410. There is insufficient dilution in the receiving stream to demonstrate that there is no reasonable potential for Outfall 001 to cause toxicity to aquatic life; however, since no effluent related toxicity occurred during the last five year permit cycle, the frequency of toxicity monitoring was reduced from semi-annual to annual under the renewed permit. The permit currently contains WET limits of 1.0 toxicity units for both acute (1.0 TUa) and chronic (1.0 TUc) toxicity. The acute limit is the effluent concentration which causes 50 percent mortality of test organisms at 96-hours (96-h LC50) and is derived using data from the chronic test. The chronic limit is based on a 7-day or 3-brood exposure of the fathead minnow and the daphnid, respectively. This permit limit is based on a 25 percent inhibition concentration (IC25) test endpoint, which means that exposure to undiluted effluent resulting in reductions in fish survival and growth or daphnid survival and reproduction by 25 percent or more would constitute a permit violation.

Both acute and chronic toxicity of ammonia to aquatic life is pH-dependent, such that at higher pH levels toxicity increases. Chronic toxicity is also temperature dependent, with toxicity increasing with increasing temperature. In addition, the presence of salmonids is a factor in determining acute criterion, and the presence of early life stages of fish at cool temperatures is a factor in determining the chronic criterion. Aquatic life acute and chronic criteria are, therefore, based on pH, temperature, and the presence or absence of certain fish species or life stages. Formulae for calculating the acute criterion, or Criteria Maximum Concentration (CMC), and the chronic criterion, or Criteria Continuous Concentration (CCC), for ammonia are provided in the recently revised criteria document (EPA-822-R-99-014, December 1999). The acute CMC is the one-hour average concentration of total ammonia nitrogen (in mg N/L) that should not be exceeded more than once every three years on the average. The chronic CCC is the thirty-day average concentration not to be exceeded more than once every three years. In addition, the highest four-day average within the 30-day period should not exceed 2.5 times the CCC.

To protect aquatic life from ammonia toxicity at the discharge point for Outfall 001, effluent ammonia concentrations that should not be exceeded at possible pH and temperature combinations are provided in Table 9. Ammonia water quality criteria would not be exceeded based on discharge concentrations projected in Table 7 and recent pH and temperature data. In addition, results (Table 10) from site specific ammonia toxicity studies conducted with daphnids and fathead minnows using ammonia spiked BRF ash pond water adjusted to three target pH levels indicated that the discharge concentrations in Table 7 should not result in toxicity which would jeopardize compliance with WET limits. As described in the previous section, operational treatment measures would be utilized to meet permitted toxicity limits for this discharge, although no negative effects from the ammonia addition are predicted.

Table 9. Maximum Allowable Ammonia Concentrations in Outfall 001 to Protect Aquatic Life at Different pH Levels and Temperatures (Assumes Salmonids absent and fish early life stages present).

	CMC (mg N/L)*				CCC (mg N/L)			
Temp	pH=7.0	pH=7.5	pH=8.0	pH=8.5	pH=7.0	pH=7.5	pH=8.0	pH=8.5
15†° C					5.73	4.23	2.36	1.06
20° C					4.15	3.07	1.71	0.77
25° C	36.09	19.89	8.41	3.20	3.01	2.22	1.24	0.55
30° C					2.18	1.61	0.90	0.40

* The CMC is not temperature dependent.

† The chronic values do not change with temperature changes below 14.6º C.

Table 10. BRF Ammonia Spike Study - Toxicity Endpoint Summary (expressed as mg/L N).

Parameter	pH 7.5	pH 8.0	pH 8.5
Fathead 96-h LC_{50}*	34.8	13.5	6.0
Daphnid 96-h LC_{50}**	46.0	25.5	11.5
CMC (25°C)	19.89	8.41	3.20
Fathead IC_{25}*	19.2	6.7	4.0
Daphnid IC_{25}**	16.3	5.2	2.5
CCC (25°C)	2.22	1.24	0.55

* Based on measured concentrations from testing conducted at 25°C.
** Daphnid results were repeated due to questionable results (i.e., initial results did not demonstrate expected pH dependent relationship. Reported results are from the second set of tests.

Surface Water Quality

<u>Resource Description</u>

BRF is located on the left bank of Melton Hill Reservoir in Anderson County, Tennessee at Clinch River mile 48.0. The main plant area is drained by Worthington Branch, and the region southeast of Bull Run Ridge is drained by Bull Run Creek. Worthington Branch, a meandering creek draining Raccoon Valley, was relocated to the south side of the valley during plant construction. The length of relocation of the creek totaled nearly 11.4 km. Bull Run Creek essentially follows its original watercourse except for straightening from the L & N Railroad bridge to its confluence with the Clinch River. An unnamed stream is also located on the plant site near the bottom ash storage areas.

Clinch River

The Clinch River originates in southwestern Virginia. It flows into Tennessee and enters the Tennessee River near Kingston, Tennessee. Two impoundments, Norris and Melton Hill, are located on the Clinch River. BRF is located 31.8 river miles downstream from Norris Dam and 24.9 river miles upstream from Melton Hill Dam. Flow in the Clinch River in the vicinity of the BRF is dependent upon the releases through the hydroelectric plant at Norris Dam and releases from Melton Hill Dam. At the plant site, the main river channel is about 8 m deep and 212 m wide.

The Clinch River watershed drains 4,413 square miles before finally emptying into Watts Bar Reservoir. The watershed supports both small farms and light industry, with heavy industry occurring in urban areas. Boating, fishing, and watersports are popular on the Clinch River. TDEC, in partnership with a coalition of federal, state and regional government agencies, nongovernment organizations, conservation groups and citizens, completed the Tennessee River Assessment Project Summary Report in 1998 that rated the Clinch River's natural scenic quality as part regionally, and part locally, significant. Recreational boating on the Clinch River was rated as regionally significant, and recreational fishing was not assessed (TDEC 1998a). TDEC's 1996 305(b) report rates Melton Hill Reservoir as not supporting its designated uses due to PCB accumulation in fish. The sources of PCBs in these areas are listed as upstream hydroelectric facilities and the DOE facilities at Oak Ridge (TDEC 1998b).

BRF plant has four NPDES permitted discharges to the Clinch River: the ash pond, condenser cooling water, waste water treatment plant, and intake screen backwash. The plant's intake channel is also located on the Clinch River, upstream from Outfall 001.

Bull Run Creek

Bull Run Creek drains a 104 square mile area including portions of Anderson, Knox, Union, and Grainger Counties and empties into the Clinch River at Clinch River mile 46.7, just south of the southwest corner of the plant boundary. The ash pond and the East and West dredge ponds are adjacent to Bull Run Creek. BRF does not have any NPDES permitted discharges to Bull Run Creek. The average flow for Bull Run Creek at mile 0.9 is estimated to be 4.25 m^3/s based on monthly measurements from 1957 to 1986 (Lowery 1986). The Tennessee River Assessment Project Summary Report rates Bull Run Creek's natural scenic quality as part regionally significant. The report did not assess recreational boating. Recreational fishing was rated as fair (TDEC 1998a). Water quality in Bull Run Creek is rated as fully supporting its designated uses in TDEC's Clean Water Act 305(b) report for 1998 except for a 2.5 mile segment in Knox County that is not supporting designated uses (TDEC 1998b, TDEC 1998c).

TVA completed surface water quality sampling of Bull Run Creek in 1990, and it is summarized in the *Bull Run Fossil Plant Groundwater Assessment* (Julian and Danzig 1996). Except for iron, water quality upstream and downstream of the BRF was quite similar. According to the *Bull Run Fossil Plant Groundwater Assessment*, the results seem to indicate no leachate contamination of the stream and significant dilution of groundwater recharge by surface water (Julian and Danzig 1996).

Worthington Branch

The fly ash stacking area, dry stacking area runoff pond, coal storage yard pond, coal storage area, and main plant site are adjacent to Worthington Branch. Worthington Branch empties into the condenser cooling water discharge channel to the Clinch River. 7Q10 streamflow data for Worthington Branch was obtained from nearby continuous gauging stations with a mean value of 0.268 cfs. The results of surface water quality sampling for Worthington Branch show that concentrations of hardness, calcium, sodium, sulfate, dissolved residue, and arsenic increase downstream. The upstream and downstream stations for Worthington Branch seem to indicate some leachate impacts, based on limited sampling (Julian and Danzig 1996).

Unnamed Stream

An unnamed stream borders the bottom ash and dry bottom ash storage area and drains into the Clinch River near Clinch River mile 47. Streamflow data was not available for this unnamed stream. The results of surface water quality sampling for the unnamed stream show that concentrations of sulfate, iron, aluminum and dissolved residue increase downstream. The upstream and downstream stations for the unnamed stream seem to indicate some leachate impacts, based on limited sampling (Julian and Danzig 1996).

<u>Potential Impacts</u>

For the no action alternative present surface water quality as characterized in the resource description section, would be expected to be maintained.

Construction Impacts

No impacts to surface water would be expected from construction and installation of the SCR reactor and associated ammonia storage, unloading and handling area, or systems. The Bull Run site is a pre-existing heavy industrial facility with BMPs already in place for control of site runoff and resulting siltation. Surface runoff that flows to the ash pond is currently permitted. Construction related runoff that discharges directly to surface waters may require an NPDES General permit. BMPs necessary to prevent erosion and runoff to surface waters would be incorporated in the SWPPP required to be developed under the General NPDES permit.

Operational Impacts

No ammonia contaminated waste streams are expected or permitted to be discharged to Bull Run Creek, and results of limited sampling of Bull Run Creek seems to indicate no leachate contamination and significant dilution of groundwater recharge by surface water (Julian and Danzig 1996). Therefore, no adverse impacts to Bull Run Creek are expected due to SCR operation.

While no ammonia contaminated waste streams are anticipated or permitted for discharge to Worthington Branch or the unnamed stream, possible leachate impacts have been observed in Worthington Branch and the unnamed stream, based on limited sampling data (Julian and Danzig1996). The combined ammonia contributions from CYDB seepage and Phase II stack infiltration could result in an ammonia concentration in Worthington Branch of approximately 2.04 mg /L or 1.69 mg/L as NH_3-N. This is below the EPA chronic aquatic life criterion (or Criteria Continuous Concentration) for ammonia of 2.055 mg/L N computed for Worthington Branch at the highest temperature and pH measured (21.3 and 7.8, respectively). Therefore, no direct adverse impacts to Worthington Branch from ammonia toxicity would be expected due to ammoniated ash disposal in the Phase II stacking area since water quality criteria are intended to be protective (conservative), although some nutrient enrichment could occur. The potentially affected reach of Worthington is on the Bull Run Reservation and is highly modified due to its previous relocation during plant construction. Worthington Branch currently empties into and mixes with the CCW discharge, which would additionally reduce any potential for impact before entering the Clinch River.

No direct negative (toxic) impacts on water quality of surface waters would be anticipated since ash pond discharges would be required to meet NPDES limits. Levels for Worthington Branch is below the CCC at highest recorded pH (7.8) and temperature (21.3 ^{o}C). The revised acute Ambient Water Quality Criterion for ammonia (EPA-822-R-99-014, December 1999) for outfall DSN001 would be expected to range from 7.0 mg N/L at pH 8.1 to 32.94 mg N/L at pH 7.1.

Groundwater Quality

<u>Resource Description</u>

The BRF plant site lies in the Valley and Ridge physiographic province. The topography of the site is typical of the province which reflects the geologic structure with a northeast strike and a southeast-dipping strata. Four different bedrock units reside beneath the site: the Rome Formation, the Conasauga and Knox Groups, and the Chickamauga Limestone. Alluvial overburden 0.6 to 8.5 m thick mantels the main flood plain of the

Clinch River west of the L&N Railroad and extends northeastward up the small tributary valleys (Bull Run Creek and Worthington Branch) to about elevation 244 m-msl. A large portion of this area at the site has now been covered by ash disposal areas.

The Chickamauga Formation underlies the main plant area, including the Phase II stacking area, and consists of a heterogeneous assemblage of limestones, shaly limestones, calcareous shales, and calcareous siltstones. Shallow fractures, enlarged by carbonate dissolution, are more common in this formation than any other at the site. Residuum produced from the Chickamauga is a silty clay containing variable amounts of chert. In the powerhouse area, the majority of this residuum has been removed. In the area of the coal yard and fly ash dry stack, residuum is expected to range in thickness from 0 to 8 m.

Groundwater at BRF is derived from infiltration of precipitation and from lateral inflow along the northwest boundary of the reservation. As indicated by the groundwater potentiometric (or water table) configuration on Figure 4, Worthington Branch is the primary receptor of shallow groundwater flow from the plant area, coal yard, and the Phase I and II dry ash disposal facilities. The subsurface water flow occurs both in a shallow zone just beneath the land surface and in a deeper zone below the water table. The area underlying the main plant area (Chickamauga Formation) may locally exhibit properties typical of an aquifer in which flow is dominated by fractures enlarged by carbonate dissolution that may store and discretely transmit relatively large volumes of water. However, the majority of the site is underlain by aquitards (Rome and Conasauga units) in which groundwater movement is controlled by fractures, and which may store fairly large volumes but transmit only limited amounts of water.

A 1999 survey of water wells in the BRF plant vicinity reported by Julian (1999) indicate that there are 17 domestic wells within approximately one mile of the Phase II stacking area (Figure 5). Well depths are unknown but it is likely that most are completed at relatively shallow depth in the Chickamauga Formation. Most residences located northeast and northwest of the BRF reservation rely on public water provided by the Clinton Utility Board.

Potential Impacts

Under the no action alternative, no effects to groundwater would occur.

Construction Impacts

Plant construction activities potentially affecting groundwater resources would be limited to excavations associated with SCR-related structures in the plant area and the ammonia retention pond. Excavations associated with these facilities would not exceed about 8 ft in depth, and would not be expected to encounter significant groundwater. Groundwater control, if needed, would be limited to short-term dewatering from excavations. On this basis, construction impacts on groundwater resources would be negligible.

Operational Impacts

Potential sources of groundwater contamination resulting from plant operations following SCR modifications include:

- Infiltration of surface releases of ammonia within the ammonia storage tank retention basin due to accidental spills or tank failure.

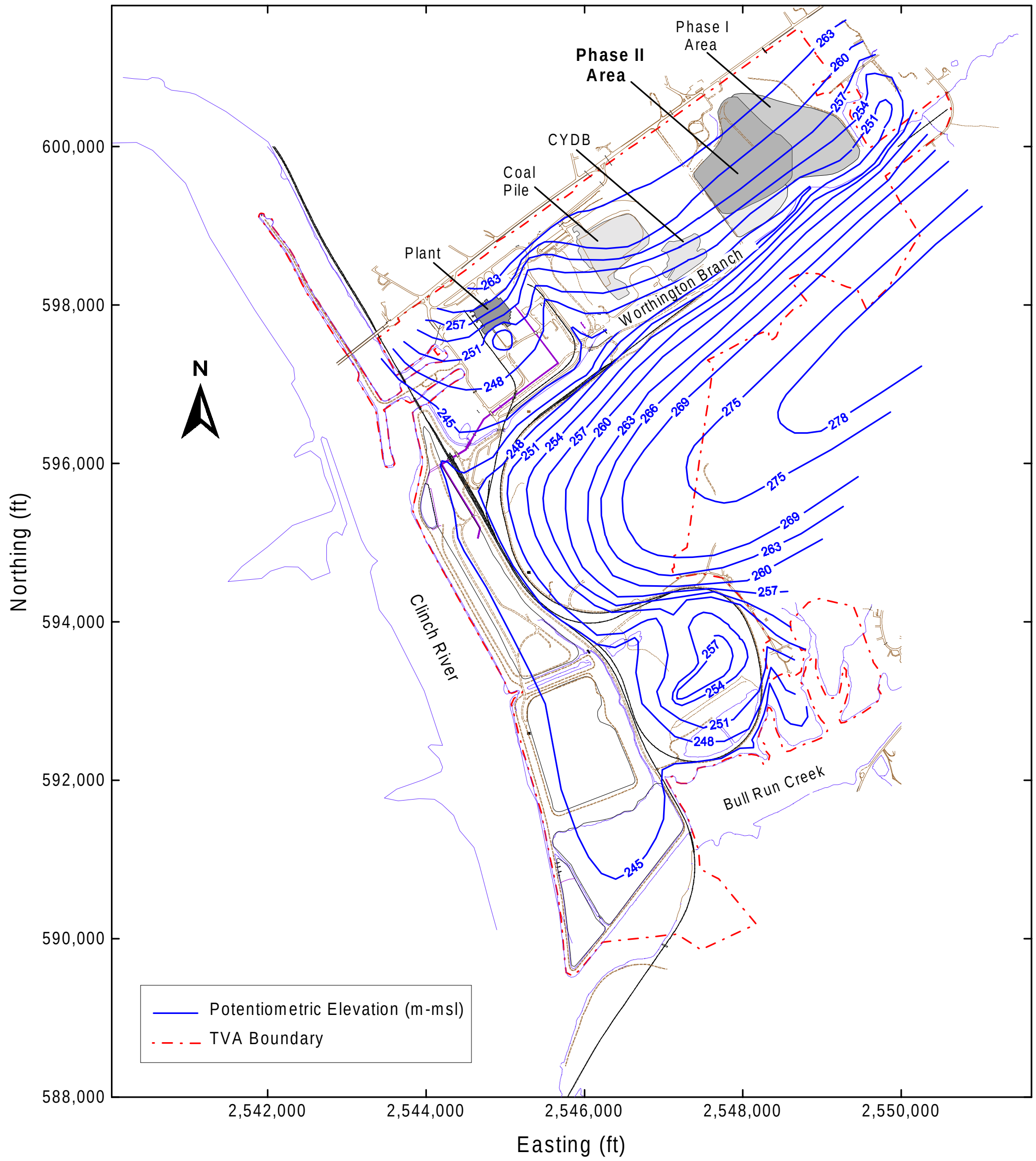

Figure 4. Groundwater potentiometric surface at Bull Fossil Plant Site - November 1991 (from Julian and Danzig 1996).

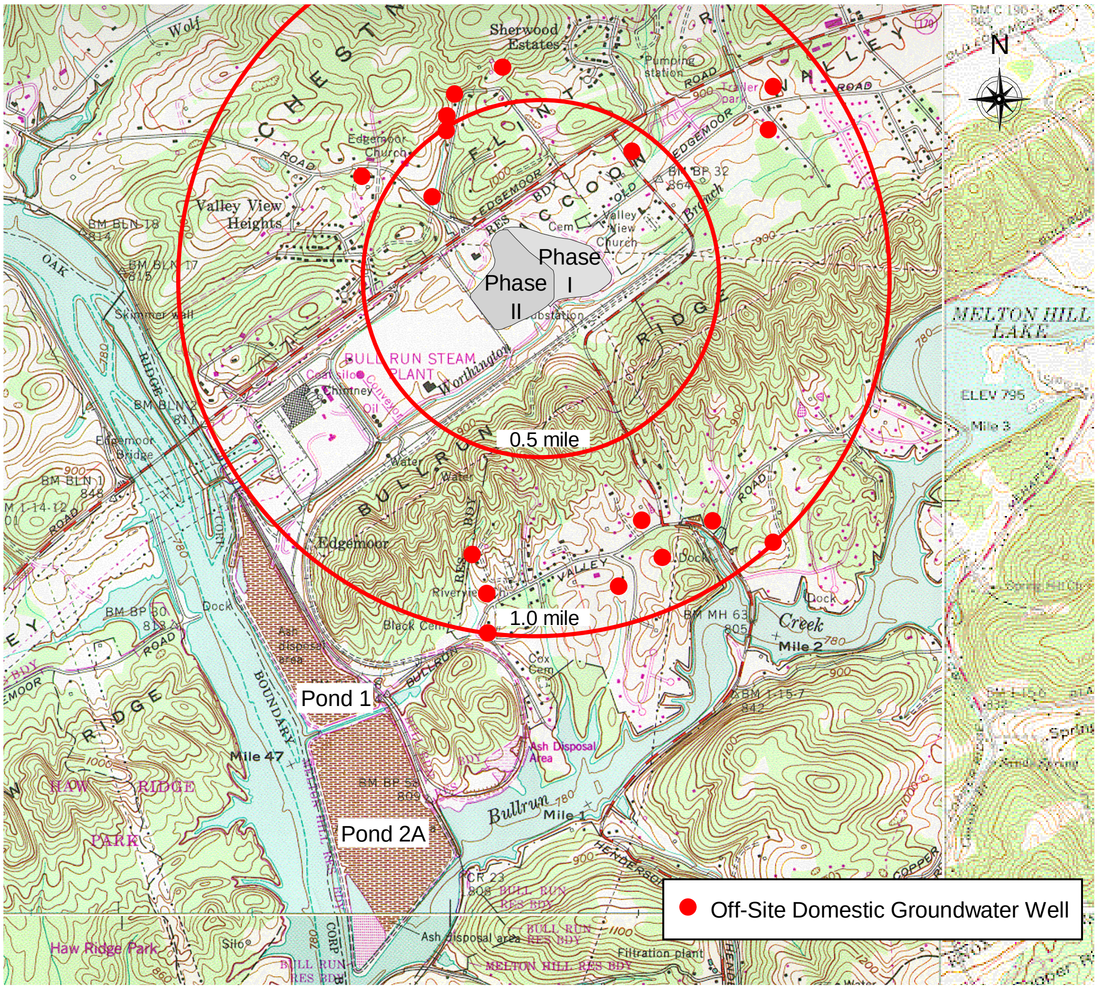

Figure 5. Private water-supply wells within one-mile of phase II ash stacking area (adapted from Julian, 1999).

- Leakage of ammonia from transfer piping.
- Leaching of ammonia from exposed fly ash deposited in the Phase II dry fly ash stacking area by precipitation, and resulting infiltration of ammonia leachate beneath the stacking area, stack runoff sedimentation pond, coal yard drainage basin, and the ash pond.

Impacts of Ammoniated Ash Disposal

For the worst case scenario, this groundwater section is written independently of the wastewater section. The wastewater section assumes that all runoff enters the wastewater stream. Assumptions for the groundwater section are included in the following.

Leachate produced by incident precipitation on exposed ammoniated ash deposited in the Phase II dry stack would be expected to either infiltrate into the underlying soil or to form runoff. In general, the relative amounts of leachate and runoff generated from a rainfall event would depend on rainfall intensity and duration, and on the antecedent moisture content of the ash.   Runoff of ammoniated leachate, along with unaffected runoff from the Phase I ash stack area, would be routed, in turn, to the stack sedimentation pond, the CYDB, and the ash pond. Historical observations indicate that runoff residence time in the sedimentation pond is negligible due to the pond control weir which allows rapid transfer of water to the CYDB. Only rarely has more than a few inches of standing water been observed in the sedimentation pond. Affected runoff entering the CYDB would mix with unaffected runoff from the coal yard and surrounding area and with pre-existing water in the CYDB. Excess water in the CYDB would be pumped, as required, to the ash pond where it ultimately discharges to the Clinch River either as an NPDES surface water discharge or as groundwater seepage. To assume worst case, the wastewater section assumes all of the ammonia slip is pumped to the ash pond.

The primary groundwater pathways of concern would be leachate infiltration below exposed areas of the dry stack area and seepage of affected runoff contained in the CYDB.   In both cases, ammonia-affected water entering the subsurface would migrate in a southeasterly direction through fractures and bedding planes of the Chickamauga Formation, and ultimately discharge into Worthington Branch (Figure 1). There are no water-supply wells along the projected pathways of leachate from either facility, and at no time would affected groundwater leave the BRF reservation (Figure 2). The nine private off-site wells located north and east of the reservation are situated upgradient of the Phase II stacking area, and would not be affected by ammoniated-ash leachate or runoff from the Phase II area. Likewise, the eight private wells on the south side of the reservation are located in an entirely different watershed and would not be affected.

Impacts of Groundwater Seepage of Ammoniated-Ash Leachate on Worthington Branch

Dry stacking of ammoniated ash in the Phase II disposal area would occur over a period of approximately six years. The maximum area of exposed ash at any particular time during the stacking period would be about 10 acres. The ammonia concentration of the ash produced by the SCR process varies over the 16,000 hour (1.8 year) life of each catalyst element. The time-weighted average ammonia concentration is 49.9 mg of ammonia per kg ash. Conservatively assuming complete leaching of ammonia from the ash by contacting precipitation, the corresponding aqueous concentration of ammonia in ash leachate/runoff is estimated to average approximately 144 mg/L.

Precipitation at BRF averages approximately 52.9 inches per year based on 1968-87 precipitation records for the NOAA gaging station in Oak Ridge, Tennessee (Julian and Danzig 1996). Hydrologic water budget studies of the Phase I dry ash facility during stacking operations in 1987-88 indicated that net infiltration of ash leachate accounted for up to 5% of total precipitation (Young 1989). This infiltration estimate is further supported by predictions of infiltration during Phase II area stacking operations reported by Young and Beard (1989). To estimate the amount of ammonia entering Worthington Branch due to ash leachate infiltration from the Phase II stack, we conservatively assume: (1) total annual leachate infiltration is 5% of average annual precipitation from a 10-acre exposed area; (2) the rate of infiltration is constant over time (i.e., daily infiltration rate is equal to 7,449 L/day; (3) ammonia concentration of ash leachate is equal to the time-weighted average concentration of 144 mg/L, and (4) no attenuation of ammonia occurs during groundwater transport due to dilution, dispersion or biochemical reaction. The resulting ammonia concentration in Worthington Branch due solely to dry stack leachate infiltration would be approximately 1.63 mg/L, assuming full mixing of affected groundwater seepage with the estimated 7-day, 10-year low flow (7Q10) in Worthington Branch (6.556×10^5 L/day).

Estimation of the ammonia contribution to Worthington Branch from seepage of ammoniated runoff contained in the CYDB is described in Appendix D. In general, the CYDB is modeled as a batch reactor in which the rate of change of ammonia in the CYDB is computed from known inflows of affected and unaffected runoff, groundwater model computed basin seepage losses, assumed pumpage to the ash pond, and the initial water volume in the basin. In accordance with the runoff measurements for the Phase I ash stack (Young 1989), the quantity of affected runoff entering the CYDB was assumed to be 5% of average precipitation for a 10-acre exposure of the Phase II stack. A runoff factor of 20% was applied to all other areas draining to the CYDB including unexposed portions of the Phase II stack, the entire Phase I stack, and the coal yard area. Ammoniated seepage from the CYDB was assumed to flow directly to Worthington Branch without attenuation, and, as before, full mixing of seepage with the estimated 7Q10 streamflow was assumed. Results indicate a maximum ammonia concentration of 0.41 mg/L in Worthington Branch from CYDB seepage alone.

The combined ammonia contributions from CYDB seepage and Phase II stack infiltration result in an ammonia concentration in Worthington Branch of approximately 2.04 mg/L or 1.69 mg/L as NH_3-N. This worst case analysis results in a concentration that is below the EPA chronic aquatic life criterion (or Criteria Continuous Concentration) for ammonia of 2.055 mg/L NH_3-N computed for Worthington Branch (see Wastewater Section). Therefore, no direct toxic impacts to Worthington Branch would be expected due to ammoniated ash disposal in the Phase II stacking area.

Socioeconomics

Resource Description

The Bull Run Steam Plant is located in Anderson County, Tennessee, near the city of Oak Ridge and a short distance from Knoxville. Anderson County is about 47 percent rural, with 53 percent of its population in the cities of Oak Ridge and Clinton. The distribution of employment in the county shows greater dependence on manufacturing than the state as a whole, with 23.5 percent of Anderson County employment, compared to 16.2 percent statewide. Conversely, Anderson County has a lower share in farming, transportation and public utilities, wholesale trade, and in the finance, insurance, and real estate sector. Total employment in Anderson County in 1997 was 45,977, including both full time and part time jobs in the county. The labor market area had 418,728 jobs. Based on current commuting patterns and on proximity, the labor market area is defined to include all adjacent counties.

Compared to its labor market area and the state, Anderson County has a larger share of its workers employed in professional jobs, technical jobs, and the more highly skilled blue collar jobs. The county has a lower share in most other occupational categories. The labor market area has a somewhat larger share of its workers in managerial, professional, technical, and sales jobs than does the state as a whole.

Population

According to population estimates by the U. S. Census Bureau, Anderson County had a population in 1998 of 71,116, an increase of 4.2 percent since the 1990 Census of Population count of 68,250. The labor market area had a 1998 population of 721,655, an increase of 10.5 percent from the 1990 total of 652,881.

The population of Anderson County is largely white, 93.9 percent in 1998 according to estimates by the U. S. Census Bureau. The remaining population is largely black, 4.5 percent of the total. The Hispanic population is estimated to be 1.0 percent of the total. The labor market area is only slightly less white, with 92.4 percent white and 6.2 percent black. The state is less white at 82.2 percent white and 16.6 percent black.

Income and Employment

Per capita personal income in Anderson County in 1997 was $22,130 or 97.5 percent of the state average of $22,699 and 87.5 percent of the national average of $25,288. The level was somewhat lower in the labor market area as a whole, $21,863 or 96.3 percent of the state and 86.5 percent of the nation. There was considerable variability, however, among the counties in the labor market area, ranging from $12,965 in Morgan County to $24,688 in Knox County.

The largest source of earnings in Anderson County in 1997 was manufacturing employment, which contributed 34 percent of the total. While comparable data for services in Anderson County are not available because of confidentiality restrictions arising from the dominance of one large employer, it is estimated to contribute at least 26 to 28 percent of the total. The next largest sector was government, with 13.5 percent.

With a civilian labor force of 35,750 in 1998, Anderson County had an unemployment rate of 3.6 percent, the same as the rate in the labor market area, and below the state (4.2), and the nation (4.5). Through the first six years of the 1990s, Anderson County had lower unemployment rates than the labor market area. However, in 1996 and 1997, the rate became somewhat higher, especially in 1997 when the county rate was 5.5 percent, higher than the labor market area (4.6), the state (5.4), and the nation (4.9).

The distribution of jobs by industry in Anderson County is similar to that of earnings, with services and manufacturing the most important sources of jobs. However, due to average wage differences and a larger proportion of part-time workers, services and retail trade account for a larger share of jobs (about 47 percent) than of earnings.

Potential Impacts

For the no action alternative the current conditions and trends for employment, income, population, community services and infrastructure are expected to continue.

Employment

During the construction period, the most intense work activity will occur during construction outages. Outage workforce for the SCR project is likely to be about 600 for a few weeks at most, with somewhat fewer for a few weeks before and after the peak. As a result, total personnel on-site during outages may reach levels as high as around 2.5 times the typical day shift at the plant. These employment spikes would be of short duration, spiking up and back down quickly, probably over a period of about one to two months. For a few months before and after the outages, a smaller number of additional workers may be on site performing construction-related work.

Based on experience at previous TVA construction projects and on the site's proximity to a fairly large labor force, it is estimated that more than 50 percent of these workers would live in the general area, close enough that they would commute rather than move, depending on worker needs elsewhere in and out of the Valley. The remaining workers would move to the general vicinity of the plant.

Income

The cost of labor for this unit is expected to be about $35 million dollars, which would be about 2.6 percent or less of total wages in Anderson County. It is likely that many of the workers would commute from other counties, however, resulting in a smaller impact on Anderson County. Spending by movers would have a small but positive impact on income in the county and surrounding area. Some individual businesses might experience substantial increases in sales.

Population

Assuming that 50 percent of the workers would move into the area, the maximum impact on population at any one time would be about 300 workers plus whatever family they brought with them. As noted above, the peaks would be of very short duration, spiking up and down over a period of about one to two months. Because of this short duration, the number of family members who would move with the workers probably would be lower than for longer-term construction jobs. It is likely that the maximum population impact at any one time would be somewhere around 600 persons, less than one percent of the current population of Anderson County. However, not all of these workers would locate in Anderson County. The distribution of this population among counties and within counties would depend largely on the availability of housing or of sites for trailers. Locations near the site or near shopping and other amenities would generally be preferred.

Community Services and Infrastructure

Impact on community services, such as police, fire, and medical, would be small because of the small size of the impact on population and because of the short duration of the maximum impact.

<u>Environmental Justice</u>

The proposed actions would physically be a minor addition to an expansive heavy industrial facility having a significant property buffer area. Therefore, there is low potential during construction for important impacts on any of the residents of the surrounding area, and there are unlikely to be any disproportionate impacts to minority or low-income populations. On the other hand, all the residents of the surrounding area, including minority and low-income residents, would benefit from the resulting reduction in NO_x.

In general, operational impacts would be minor and not noticeable to residents of the surrounding area. However, there is a small probability of ammonia releases, as discussed above. In the unlikely event of such releases, demographic data for areas around the site indicate that there would be no disproportionate impacts to minority or low-income populations. Data indicate that, as of 1990, the part of Anderson County in which the plant is located, Census Tract 213.02 (a Census of Population subcounty geographic unit), has a small minority population (2.8 percent) and that 14.7 percent of the population has income below the poverty level. The immediate area around the plant has a considerably lower share of minority population and of persons below the poverty level than does the state as a whole (Table 11).

Table 11. Plant Vicinity Demographics for Minority and Low-income Populations.

Distance from site	**Total Population, 1990**	**Minority Population (Nonwhite and White Hispanic) (%)**	**Low-income Population (% below poverty level)**
5.8 km (3.6 miles)	15,754	4.1	9.2
11.1 km (6.9 miles)	67,523	5.6	10.5
Tennessee	4,877,203	17.4	15.7

Transportation

<u>Resource Description</u>

BRF is served by highway and railway modes of transportation. Portions of the existing transportation network in the vicinity of the plant are shown in Figure 6. The plant is located in Anderson County, Tennessee, approximately 14 miles west of Knoxville, Tennessee. Truck and automobile access to the plant is via State Route 170 (Edgemoor Road) approached from the east via U.S. Hwy 25W, and approached from the west via SR 62-S (Oak Ridge Hwy/Pellissippi Parkway) from Knoxville, Tennessee and via State Route 62-N or Melton Lake Drive from Oak Ridge, Tennessee. State Route 170 is a paved two-lane highway with wide shoulders, traversing rolling countryside. SR 62 is fed from the south by SR 162 (Pellissippi Pkwy), a direct route

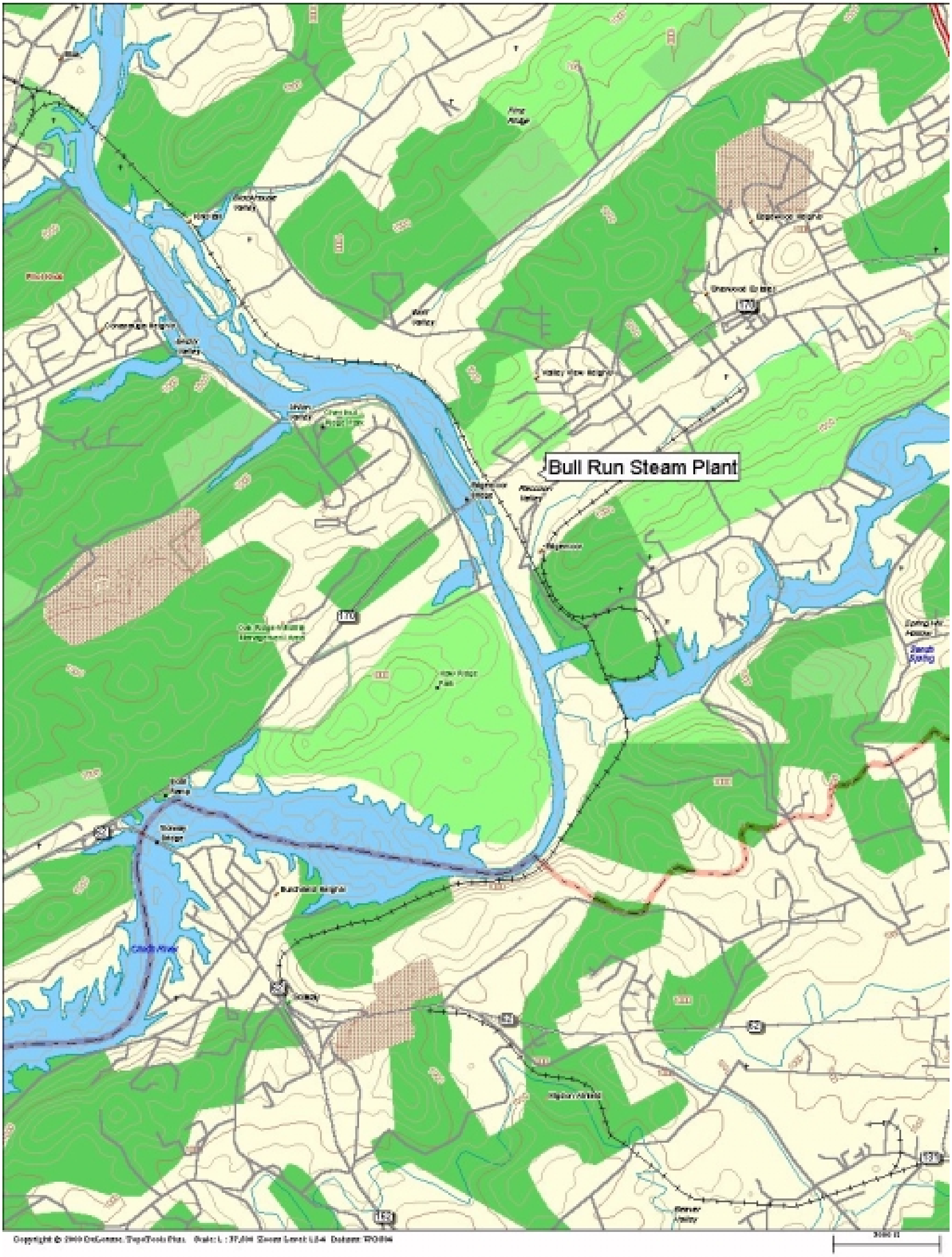

Figure 6. Transportation network in the vicinity of Bull Run Fossil Plant.

from Knoxville via Interstate 40 to the south. The following table shows the Average Daily Traffic (ADT) counts (Reference *1998 Average Daily Traffic* report prepared by the Tennessee Department of Transportation; 1999 Traffic Counts per City of Oak Ridge Engineering Department).

	ADT
State Route 170-E	15,520
State Route 170-W	12,490
State Route 62-S	42,310
State Route 62-N	35,670
Melton Lake Drive	9,030 ('99)

CSXT operates a main north-south line rail and serves BRF, providing coal deliveries.

Potential Impacts

The no action alternative would have no effects on the existing transportation infrastructure in the vicinity of BRF.

By building a SCR facility at BRF under the action alternative, there will be minor impacts to the state and county roads during both the construction and operational periods. Additional traffic generated would be for construction of the facility itself, and the construction of a railroad spur into the plant from the mainline. The construction period for this single unit plant will be approximately two years, with the peak workforce about 600 employees for up to 70-80 days. Assuming an average ridership of 1.6 persons per vehicle, and a trip in and out each day, about 750 vehicles will be added to the road network due to daily commuters during this period.

There will also be additional traffic added to the road network throughout the day in the form of construction material deliveries to the site. These deliveries may be by barge, rail or highway. Barge deliveries may total 25 over a several month period preparing for or during the outage. Some additional delay may be experienced at the signalized intersection of State Road 170 and Melton Lake Drive at shift changes. The people primarily experiencing the delay will be the construction commuters and commuters traveling to and from energy research and development facilities in and around Oak Ridge. Such a problem can be easily tolerated for the duration of the construction period. The employment levels will spike to peak levels in short durations, rising and falling quickly over a period of one to two months. A much smaller number of additional workers may be on-site performing construction-related work during the few months before and after the unit outage. In the long term, operation of the SCR would not generate any noticeable additional traffic for the roads in the local area. The roads in this area are fully capable of absorbing this additional traffic with no drop in the existing level of service currently provided to the road users. The potential traffic impact for both the construction and operational phase of the SCR is insignificant.

The ammonia unloading facility will be sited on the south western side of Bull Run Fossil Plant near the CSXT mainline rail and east of the coal storage area. A short spur and turnout would be added to the existing mainline track west of the proposed unloading facility.

After construction is completed, operation of the SCR will require ammonia deliveries of approximately one tank car per week via railroad, or three to four tanker trucks per week as a backup if rail operations are interrupted. Neither delivery method would affect the capacity or level of service currently provided by the existing railroad or road network.